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LAND
TENURE
ADJUSTMENT
STRATEGY

PLANNING FOR PRIVATE USE IN THE CALIFORNIA DESERT

PREPARED FOR:

CALIFORNIA DESERT PLAN PROGRAM
BUREAU OF LAND MANAGEMENT
U. S. DEPARTMENT OF THE INTERIOR
3610 CENTRAL AVENUE
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BY

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POMONA, CALIFORNIA 91768

July 1, 1979

This work was carried out within the School of Environmental Design at the California State Polytechnic University in Pomona. The three principal authors are members of the faculties of landscape architecture and urban planning.

The Desert Slope study presented in Part D was executed by graduate students Ronald Ganzfried and John Petrovsky, and the analyses and descriptions of desert ecosystems included with the Desert Slope study were carried out by graduate students Lisa Randall, David Seret and Gail van der Bie, all working under the direction of coauthors Lyle and Jokela.

Numerous other students have participated in several related research efforts, studies, projects, and class assignments in recent years. Their enthusiasm, their questions and their interest in sensitive desert planning have been a considerable help in executing this project.

The report was prepared with the active aid and counsel of the BLM Desert Plan Program staff. The efforts of Martin Prisco and Michael Giblin were particularly important to the results.

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INTRODUCTION

The purpose of this report is to provide, within the very broad framework of the Bureau of Land Management's California Desert Planning Program, a source of guidance in applying the assembled Desert Plan data and policies to a specific local land management concern of the Bureau — the need of adjusting patterns of land tenure to meet the policies of Public Law 94-579, the Federal Land Policy and Management Act of 1976 (FLPMA).

The report addresses problems of resource management planning at the level of the "resource area," the smallest administrative subunit of a BLM district, and the area for which a resource management plan is to be prepared. Such plans are mandated by FLPMA and the Proposed Planning Regulations that derive from it. The latter are in the final stages of preparation and review at the time of this writing in Spring of 1979.

A particular purpose of this report is to develop a method, in conformance with FLPMA, for determining the future management of irregular "checkerboard" areas of public and private land ownership in the California Desert Conservation Area (CDCA). When applied, such a method should result in a tenure pattern that maximizes the management capabilities of BLM, of local and state government, and of private organizations and individuals—all of whom are capable of addressing FLPMA goals, with the concurrence and support of the others. By taking appropriate and timely initiatives, and by actively collaborating with other interested parties, the BLM Area or District Manager can retain his flexibility, and expand upon his options in managing public lands.

FLPMA imposes planning and management burdens on the BLM manager that are distinctly different from his traditional role. Historically, the Manager and the Bureau as a whole have been primarily concerned with present and potential *economic* values of the public lands under their control, while secondarily making needed allowances for factors such as wildlife habitat and watershed maintenance. The national interest has tended to be defined in terms of the Bureau's institutional interests as a controller of land. FLPMA greatly *expands* the definition of national interest, specifically drawing attention to *non-economic* values, and particularly to environmental concerns. The law does not take the position, however, of leaving the federal lands "as is." Traditional purposes such as recreation, mining, and community development are to be encouraged, but with much greater planning sensitivity. Leasing of land for such purposes is to be developed as a method of land tenure, under continuing federal ownership.

Substatially increased staffing and budgeting are not indicated in the new law; yet the above points, if taken as added burdens beyond existing responsibilities, would clearly appear to require more staff. Increased coordination with plans and programs of local and State as well as other Federal agencies is mandated in the new law. Much more than simple "60-day notice" of proposed actions is indicated in the law and the draft of implementing regulations. It is not clear how this will all be achieved with a staff that is already overloaded with day-to-day administrative duties. Land tenure changes that would consolidate or "block up" Federal ownership could be one means of easing staff burdens, but they are now discouraged by internal Bureau directives, on grounds that staff time is not available, and because the principal former method—that of land exchanges—is particularly time consuming, generally requiring years to complete a transaction.

Under the new law, the Bureau is enabled and encouraged to function more along the lines of other real estate operators, recognizing, of course, the intention of serving a broad national interest—which may in many cases reasonably include private development and use as the highest national need. Purchases and sales of land are more freely allowed; exchange of money is permitted as part of a land exchange; and speculative values for uses other than current ones are now permitted to be recognized in each transaction.

In the light of these various points of shifting policy and priorities, it would seem apparent that a shift of strategy is in order for the District Manager, and for the Bureau as a whole. Conserving staff time is particularly critical as a management objective. Some devices to this end may be relatively simple to implement, such as requesting or requiring proposers of projects—particularly of major ones—to read FLPMA, to perform their own policy analyses, and to consult BLM staff before major commitments are made that would later require expensive changes and demanding negotiations.

The major points of land tenure change of concern to the land manager, and of interest in the present report are the following:

- whether to consolidate public land holdings and retain them;

- whether to dispose of certain public lands through sale or trade;

- what conditions to impose on such transactions in order to satisfy environmental or other requirements;

- whether to develop public properties under Federal ownership through leaseholds or other such mechanisms;

- whether and if so, where to grant right-of-way easements for roads, aqueducts, and other private or public works;

- whether to restore existing withdrawals or enact additional withdrawals necessary to protect the environment.

- how to address and satisfy environmental issues in each action, including Native American values and concerns.

In addressing such questions, the manager must also judge and resolve what level of leadership and entrepreneurship to exert in dealing with county government, existing owners and/or residents, potential users, and any other interested parties.

Clearly, this is a highly complex subject. Many alternatives are available; in some ways, the manager's ability to act and his range of possiblities is increased as a result of FLPMA. But in view of the many new constraints it imposes, utilizing new types of opportunities under FLPMA will require considerable enterprise and flexibility on the part of BLM staff.

In view of the limited budget and numbers of staff available to BLM, and noting the particular importance of land tenure issues, the authors of the present report conclude that the Bureau will need all the help it can get in implementing the new mandates. From that viewpoint, we have particularly sought to throw light on tactical approaches that may aid staff in delegating some of the detailed planning and management processes to others, while maintaining effective management control overall. We especially address the following questions: How can public land be responsibly place under the control of private or institutional interests in ways that will benefit the public and satisfy the laws and the purposes of the Bureau? How can this be done effectively at a bare minimum cost to the Bureau, through devices such as performance standards and project fees?

To state the case most directly, the Bureau should *not* take a defensive posture in implementing the new requirements of FLPMA. On the contrary, an active role in selectively *helping* the development process in the desert is indicated. At the same time, development values and bargaining leverage of the Bureau can be utilized to unravel and resolve some of the existing land tenure problems of the desert, most notably in the checkerboard areas. These areas cannot be managed efficiently with limited staff, and pose an urgent set of problems for Bureau staff to resolve.

PART A

FOUNDATION IN PUBLIC POLICY

CHAPTER A·I

PROBLEMS AND ISSUES

In many instances, the ultimate determination of uses of the desert will be made by persons or institutions outside the BLM. It should be the role of BLM to establish the framework within which decisions can be made and to work within the context of those institutions to insure that the long term interests of the nation will be protected. In this regard the BLM finds itself in a position not greatly different from that of a large scale private land owner who sees the potential for use of his land increasing over a prolonged period of time. It may be impossible for that private owner to predict the vagaries of long term demand; however, he must establish a process by which long term goals can be established and programs created which will carry out the goals as trends emerge. In contrast to small scale land holders who can concern themselves with short term returns on

Quality development with environmental sensitivity.

investment, the large scale developer must recognize that the potential for continued success in the distant future, whatever shape development might take at that time, is predicated upon the successes which are achieved in the initial stages of the process. Thus, while the single owner cannot control the entire process himself, he must work to insure that those other decision makers with whom he deals (governmental agencies and other development forces, for instance) are acting in his best long term interest. Such a situation demands that the large scale developer establish a program (and a reputation) for seeking a quality environment in order to stimulate the desired long term profit expectations.

While the BLM is not concerned with the same profit motives, *per se,* in the disposal of land, it is necessary to examine the public interest in the desert in a similar fashion. Other interests may be concerned with short term gains but the BLM is uniquely positioned to represent a wide range of public interests concerned with the future of the California Desert. Other governmental agencies will share much of this same responsibility, and local government is particularly important because it will bear the eventual responsibility for regulating private land uses and providing services to private holdings. Chapter B-IV will return to the particular role of the local agencies, and the Bureau's relationship to them.

The use of all California desert resources can and should be provided for in a multiple use and sustained yield management plan to conserve these resources for future generations, and to provide for present and future use and enjoyment . . . FLPMA Se. 601(a)

EXISTING PROBLEMS TO BE RESOLVED

Many of the existing land tenure problems of the desert are the direct result of policies and programs that existed prior to the passage of the Federal Land Policy and Management Act (FLPMA).

The Bureau of Land Management was formerly viewed primarily as caretaker of Federal lands that nobody else wanted. Management directives were oriented toward development and exploitation: if a legitimate use could be found for public lands, users were encouraged to take title, easement, or lease to the needed lands usually with little or no residual federal control. The result now observable on the land is a fragmented pattern of frequently competing uses. This is primarily a reflection of national awareness and congressional intent, rather than the result of specific Bureau initiatives.

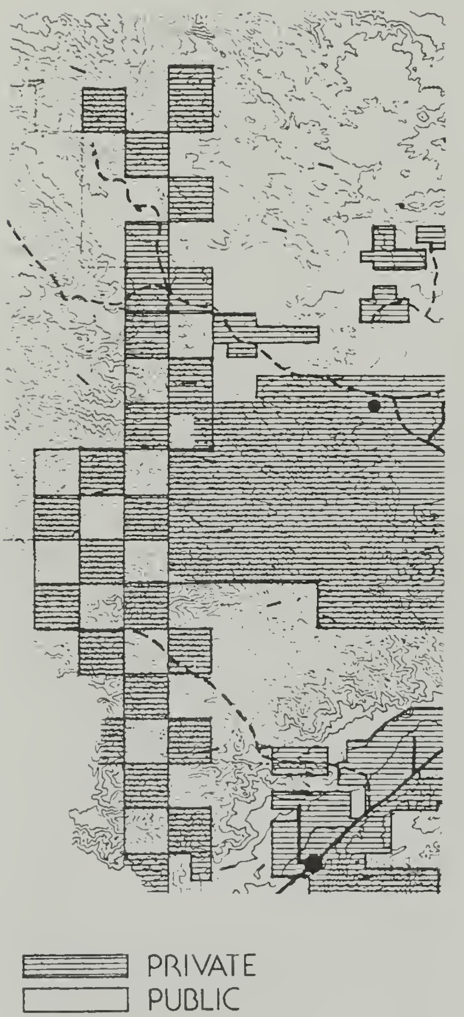
New roles for the Bureau.

FLPMA, by contrast, provides not only defined Federal policy with respect to public lands, but also the authority for the Bureau to carry out a broad resource management program based on multiple use and sustained yield priciples. Emphasis is upon stewardship, not exploitation; on recognition, protection and development of environmental values; on extensive public participation; and on coordination with other agencies in planning.

The Bureau's role and management function may have changed more drastically than any other continuing Federal agency as a result of changing national awareness of the environment during the 1970s. Previously neglected lands are now viewed by the public and the government as having high environmental values. National and State surveys of public opionion conducted for the BLM Desert Plan staff reaffirm these values, and particularly stress preservation of the desert as a desire of the public.

The Congress declares that it is the policy of the United States that. . . the national interest will be best realized if the public lands and their resources are periodically and systematically inventoried and their present and future use is projected through a land use planning process coordinated with other Federal and State planning efforts. FLPMA Sec. 102(a)

In addressing the new program approaches introduced by FLPMA, Bureau staff as well as observers and potential critics should be aware that a watershed boundary has been passed in public attitudes; the Bureau is still responsible for implementing public wishes as they are interpreted by the Congress, and should not be held accountable for past actions taken



under different mandates. Those old actions in fact make the work of Bureau staff more difficult because they do not conform to the newly articulated needs. The land manager still lives with the results, and rather than defending prior decisions should consider it part of his job to adapt the former results to new thinking and policy.

The following programs are representative of situations to be addressed:

1) Small Tract Act of 1938

Under this Act, the Congress enabled and encouraged the BLM to dispose of five-acre tracts of land to private individuals who would use and develop the land for homesites, small scale farms, and businesses. A massive demand for such tracts materialized in the early 1960s when it became apparent that California Aqueduct water would flow along the edge of the Mojave Desert, and that the Palmdale Airport would be developed as a major air terminal for Los Angeles.

During the 1960s, approximately 75,000 of these tracts were granted to individuals for the nominal sum of $15. An additional 12,000 were granted as recently as the early 1970s. Few of these were actually utilized as intended by the Congress. The vast majority were acquired by individual speculators from outside the area.

Numerous management problems exist in these tract areas:

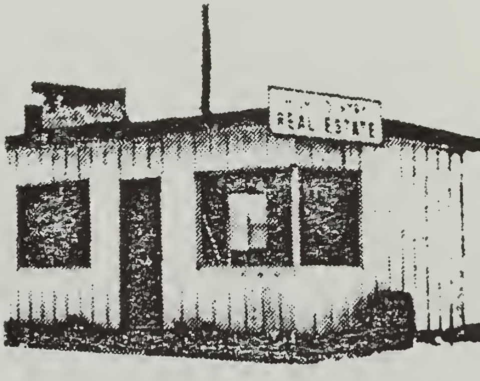
- The tracts are too large to form viable community clusters; they are very expensive to service with utilities, roads and amenities.

- Their use brings about a great deal of energy-consuming individual automobile travel.

- They blight the visual landscape with small, scattered, often poorly-maintained structures.

- The location and boundaries of these tracts are often vague or unknown.

- Scattered Federal holdings among them are susceptible to illegal use or inclosure, and to conflict that is demanding of BLM staff time, especially if the policy mandates of FLPMA are taken seriously.



2) **Congressional Grants to Railroads**

A second pattern of interspersed Federal and private ownership known as the "checkerboard" exists where alternate sections of land were granted a century ago by the Congress to the Southern Pacific Railroad as an incentive to construct the rail line through the desert.

As noted in the report of a recent BLM meeting attended by Mr. Bill Herbert, Vice President and General Manager for Natural Resources of Southern Pacific Land Company, the company

> has owned about a million acres south of the Tehachapi Mountains for over a hundred years. When the land was originally acquired, Southern Pacific acted as a real estate dealer and sold off the property as fast as they could to help develop the west. Since 1947 when their policy was changed, lands have been held for their long-range income potential. Mr Herbert said, "Where the property does not meet our long-range goals of management. . . we want to exchange and make adjustments of this property. . . Our goals have been to exchange lands with the BLM and acquire commercial lands that are in non-sensitive areas in the path of development. . . We feel if it

C.D.C.A. Advisory Committe Meeting, February 1-2, 1979. Sar Bernardino, California. Page 5

> is a wilderness type use, it should be in government ownership, if the public is going to have a non-commercial enjoyment of the property."
>
> In 1966 Southern Pacific opened an office in San Bernardino to handle the land exchange program, but closed it in frustration last year because of the unsatisfactory results.

Same source, page 4

> (The Company now) owns approximately 819,000 acres within the CDCA. Exchanges are complicated by factors such as existing rights on the private land which cloud a title, and mineral leases to third parties.

3) School Trust Land Grants

A further form of "checkerboard" is the

Same source, page 8

> 600,000 acres of State school trust lands, including mineral interests. When California became a state, Congress granted it Sections 16 and 36 of each township ". . . for the purposes of public schools in each township. . ."

In unpopulated areas of the desert these lands are not, of course, used for schools. According to Mr Bill Northrop of the State Lands Commission,

> the answer is to adjust the scattered ownership of the desert into blocks of land which can be effectively used by the State. . . This will require manpower and funds not available to the Bureau of Land Management.

THE NEED FOR ACTION

New strategies and programs are needed simply to reverse the effects of past actions, and also to satisfy new demands for use of the desert. Many of these are addressed in BLM Desert Plan reports on "Future Demographic and Economic Trends in the California Desert" and on "Future Technology in the California Desert."

Energy needs are likely to bring a variety of new demands for desert use, for solar and geothermal energy as well as traditional thermoelectric plants and related rights of way.

New types of desert community.

New residential modes are likely to evolve, for commuters traveling to work in existing urban areas, and for additional, more independent economic units. Rapid strides in communication technology will meanwhile make the desert seem far less isolated. New biological technologies, including enclosed, agricultural environments utilizing recycling methods, will provide additional independence and income potential.

Residents of such new communities are very likely to be in sympathy with the purposes of FLPMA and other environmental laws — moreso than residents who came to the desert, for example, under the Small Tract Act of 1938. They could be intentionally cultivated as a Bureau "constituency" under the new law.

The most urgent need for staff effort to resolve existing land tenure problems will occur when the Desert Plan is completed in late 1980. A surge of demands on staff time for new uses can be anticipated. The Desert Plan will provide a general pattern of guidance for land tenure adjustment in the form of mapped polygons showing areas broadly intended for acquisition, disposal, or withdrawal. Much of the detail will be left to the District Manager to work out, however.

A program of detailed analysis, review, and adjustment is needed to bring the ownership of the desert into manageable patterns, and to bring the Bureau of Land Management's role and responsibilities into reasonable conformance with its mandate under FLPMA and other Federal laws. Such efforts now appear to have low priority within the Bureau. In the absence of a high level internal policy change, it seems unlikely that a separate program of the required scope will be undertaken specifically for land tenure adjustment.

LEGAL MANDATES, GOALS AND OBJECTIVES

CHAPTER A-II

The Federal Land Policy and Management Act of 1976 (FLPMA) establishes a new set of policies, rules and priorities for the utilization and development of lands under Federal control. The Act arose from a recognition by Congress and the public at large that the old rules simply did not work, particularly with regard to the effective protection and development of environmental values — values that increased greatly in public estimation in the years just preceding the passage of FLMPA.

These values have been expressed with particular strength in the State of California which has evolved in the past two decades through a uniquely intensive experience of implementing a succession of State laws for land policy and management. It is appropriate that the first intensive, programatic application of FLPMA

California: a special case.

should occur here, through implementation of planning activities for the California Desert Conservation Area, mandated in Section 601 of the Act.

FLPMA is similar in policy and in intended practice to the analogous California laws. It will look very familiar to a broad spectrum of California public officials, citizen activists, public interest organizations, private developers, and professional consultants in planning, design, and environmental analysis. If Bureau staff choose to work openly and cooperatively with these groups — as FLPMA mandates particularly through the proposed implementing regulations — they may find an extensive resource base available to assist in implementing the law. On the other hand, if these groups perceive or suppose that FLPMA is being poorly enacted in California, they may find the Bureau an easy target for many highly evolved forms of legal, technical, and political action that could thwart and retard Bureau purposes.

FLPMA represents a reaffirmation of the intent of Congress articulated in the National Environmental Policy Act of 1969 (NEPA), together with an explicit application of NEPA to Federal lands — in particular to the Bureau of Land Management and its areas of responsibility.

NEPA provides not only an essential historic motivation for FLPMA; it also imposes direct demands on BLM and other Federal agencies by requiring explicit attention to the direct and indirect effects of governmental projects through the preparation of environmental impact statements. However, that requirement was almost a Congressional afterthought on an Act whose main purpose was the declaration of substantive national *policies* toward the environment. These statements have the force of law, through their repeated interpretation of Congressional intent by the judiciary. Much of the present body of Federal and State environmental law has emerged from significant legal cases, many of them brought or pleaded by a new constituency of activist legal officers of public agencies, as well as public interest law organizations. The grazing management case of NATURAL RESOURCES DEFENSE COUNCIL, et al., v. CECIL D. ANDRUS, et al. (amended final judgement, April 14, 1978) is an example that is of immediate interest to BLM; under the ruling of that case, the Bureau is required to thoroughly reassess its entire program of grazing lease management in 153 areas approximating a total of 171,801,000 acres.

A demanding new constituency.

Among the many states having environmental policy laws similar to NEPA, California's rapidly evolving and highly sophisticated experience under the California Environmental Quality Act of 1970 (CEQA) has considerable relevance to the national level, particularly in land management. The environmental impact reporting requirement applies in California to virtually *every* public or private action that is likely to have an impact. The policy declarations of CEQA are moreover stronger an more explicit than those of NEPA.

Local government forms of organization in California are highly variable in their approaches to environmental planning and analysis. However, a distinct evolution and convergence has occurred in recent years toward simplification, focus, and brevity of environmental impact reports. Emphasis has increasingly been given to mitigation of specific impacts, and to thorough exploration of realistic alternatives to any proposed actions.

§ 1502.14 Alternatives including the proposed action.

This section is the heart of the environmental impact statement. Based on the information and analysis presented in the sections on the Affected Environment (§ 1502.15) and the Environmental Consequences (§ 1502.16), it should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public. In this section agencies shall:

(a) Rigorously explore and objectively evaluate all reasonable alternatives and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated.

(b) Devote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate their comparative merits.

(c) Include reasonable alternatives not within the jurisdiction of the lead agency.

(d) Include the alternative of no action.

(e) Identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference.

(f) Include appropriate mitigation measures not already included in the proposed action or alternatives.

NEPA REGULATIONS

An aspect of NEPA's continuing evolution that could be highly significant to BLM and to the Desert Plan is the rewriting of the implementing regulations. The latest revision, completed in November of 1978, represents a thorough reinterpretation of the Federal government's role and activity in the field of environmental quality.

As in California local practices, major changes are taking place in the process and role of environmental analysis in federal planning; this may be seen clearly in the following:

> These regulations reduce paperwork requirements on agencies of government. Neither NEPA nor these regulations impose paperwork requirements on the public.
>
> i. *Reducing the length of environmental impact statements.* Agencies are directed to write concise EISs (§ 1502.2(c)), which normally shall be less than 150 pages, or, for proposals of unusual scope or complexity, 300 pages (§ 1502.7).
>
> ii. *Emphasizing real alternatives.* The regulations stress that the environmental analysis is to concentrate on alternatives, which are the heart of the process (§§ 1502.4, 1502.16); to treat peripheral matters briefly (§ 1502.2(b)); and to avoid accumulating masses of background data which tend to obscure the important issues (§§ 1502.1, 1502.15).
>
> iii. *Using an early "scoping" process to determine what the important issues are.* A new "scoping" procedure is established to assist agencies in deciding what the central issues are, how long the EIS shall be, and how the responsibility for the EIS will be allocated among the lead agency and cooperating agencies (§ 1501.7). The scoping process is to begin as early in the NEPA process as possible—in most cases, shortly after the decision to prepare an EIS—and shall be integrated with other planning.

The final documentation of the BLM Desert Plan represents an innovative approach to the kind of simplification and consolidation of documents that is specified in these regulations. The Plan and its environmental impact statement are combined into a single integrated package. The planning study for the Desert Slope area of San Bernardino County, which is presented as a case study in Part D of this report, is a smaller scale and more specifically directed example of this approach. In this case, the explicit objective of the project is the resolution and mitigation of environmental problems; environmental analysis is an integral part of the planning approach. One other aspect of the Desert Slope study is very significant: as a whole, it represents an alternative policy approach to the management of this portion of the desert, in that it does not assume that major new imports of water or energy will be provided; it does allow, however, for substantial added development, based on fuller exploitation of idigenous resources.

Merging the plan and the EIS.

The general approach suggested in the present report of collaborating with other agencies and organizations in planning and development, rather than consulting them after the fact, is responsive to requirements of consultation and coopeation in the regulations implementing NEPA (part 1501) and FLPMA (Sec. 1601.4).

OTHER POLICIES, OTHER LAWS

For general guidance on the legal mandates, goals and objectives of the Bureau and the Desert Planning Program, reference may be made to a summary prepared by the California Desert Plan Staff entitled "Laws and Policies Relating to the Planning and Management of the California Desert Conservation Area." Several points of special interest to the present study are noteworthy:

The Appendix contains additional quotes from FLPMA.

- Specific findings, policy, and implementation elements for the California Desert Conservation Area (CDCA) are spelled out in FLPMA Section 601.

- The following policy statements in FLPMA are important guides to the future tenure of present public lands:

  Sec. 102(a)(1)

  > The public lands shall be retained in Federal ownership, unless as a result of the land use planning procedure provided for in this Act, it is detemined that disposal of a particular parcel will serve the national interest.

  Sec. 302(b)

  > In managing the public lands, the Secretary shall, subject to this Act and other applicable law and under such terms and conditions as are consistent with such law, regulate, through easements, permits, leases, licenses, published rules, or other instruments as the Secretary deems appropriate, the use, occupancy, and development of the public lands, including, but not limited to, long-term leases to permit individuals to utilize public lands for habitation, cultivation, and the development of small trade or manufacturing concerns.

Sec. 102(a)(8)

> The public lands (shall) be managed in a manner that will provide for outdoor recreation and human occupancy and use.

One further item of particular significance to the Desert Slope area is the section of FLPMA controlling rights of way, which will affect the passage and the location of any proposed aqueducts to service or pass through the area:

Sec. 505. Each right-of-way shall contain—

> (b) such terms and conditions as the Secretary concerned deems necessary to (1) protect Federal property and economic interests; (2) manage efficiently the lands which are subject to the right-of-way or adjacent thereto and protect the other lawful users of the lands adjacent to or traversed by such right-of-way; (3) protect lives and property; (4) protect the interests of individuals living in the general area traversed by the right-of-way who rely on the fish, wildlife, and other biotic resources of the area for subsistence purposes (5) require location of the right-of-way along a route that will cause least damage to the environment, taking into consideration feasibility and other relevant factors; and (6) otherwise protect the public interest in the lands traversed by the right-of-way or adjacent thereto.

OBJECTIVES OF LAND TENURE ADJUSTMENT

In view of the foregoing legal mandates and requirements, and considering the framework of problems discussed in the preceding chapter, the following specific objectives will be addressed in the remainder of this report; they may be regarded as an appropriate initial framework for undertaking the adjustment of land tenure in the California Desert.

1. TO PROVIDE FOR CONSERVATION OF DESERT RESOURCES. The ecologically and esthetically valuable landscapes and processes of the desert should not be degraded. Where they have already been degraded, they should be restored, to the extent that it is possible to do so. This means that an inventory and analysis of land resources, conditions and ecological processes should form the basis of any management method.

2. TO PROVIDE FOR USES OF PUBLIC LANDS THAT WILL BENEFIT THE PUBLIC AND THAT WILL COMPLEMENT AND AUGMENT THE AMENITY AND UTILITY OF NEARBY PRIVATE LANDS. Within the limitations imposed by the overriding requirement for conservation, this will mean providing for recreation and other uses. The method should therefore include techniques for the determination of relative inherent suitability of the land for various human uses and, where possible, for multiple use.

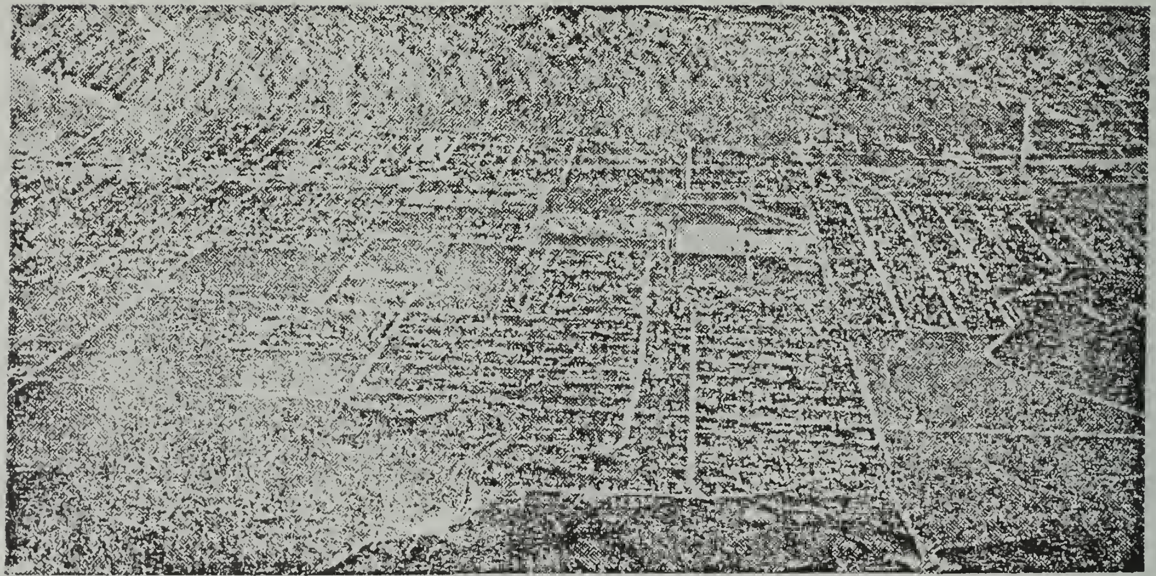
3. TO ESTABLISH PROGRAMS FOR LAND

CONVEYANCE THAT WILL PROVIDE FOR ECOLOGICALLY STABLE AND BENEFICIAL PATTERNS OF PRIVATE USE. This will mean defining the most appropriate locations for private use and describing the most fitting forms of settlement and technologies of development and support. Effective controls will be needed.

4. TO DEVELOP HUMAN USE WHILE LIMITING IT TO A LEVEL THAT CAN BE SUPPORTED BY EACH AREA'S AVAILABLE RESOURCES. The limiting factor in the desert environment is usually water. An analysis of water flows in the subject area and estimates of available quantities will form a basis for establishing carrying capacity. Future changes in the water regime, including the possibility of imported water, should be considered.

5. TO REACQUIRE LANDS THAT HAVE BEEN CONVEYED TO PRIVATE OWNERSHIP BUT WHICH COULD BE MORE BENEFICIALLY MAINTAINED UNDER PUBLIC CONTROL. While this will be a long-term process, it is important to establish the criteria for identification of such lands, and institute a program for accomplishing it as soon as possible. The means of reacquisition, such as land trades and tax benefits, should be explored.

6. TO COOPERATE WITH OTHER PUBLIC AGENCIES AT VARIOUS LEVELS OF GOVERNMENT IN THE MANAGEMENT OF ADJACENT AND INTERSPERSED PUBLIC AND PRIVATE LANDS. These relationships are complex, involving a variety of local, federal and, in some cases, state agencies. Their respective roles and responsibilities require clear definition. Additional techinques for communication and cooperation will be needed.

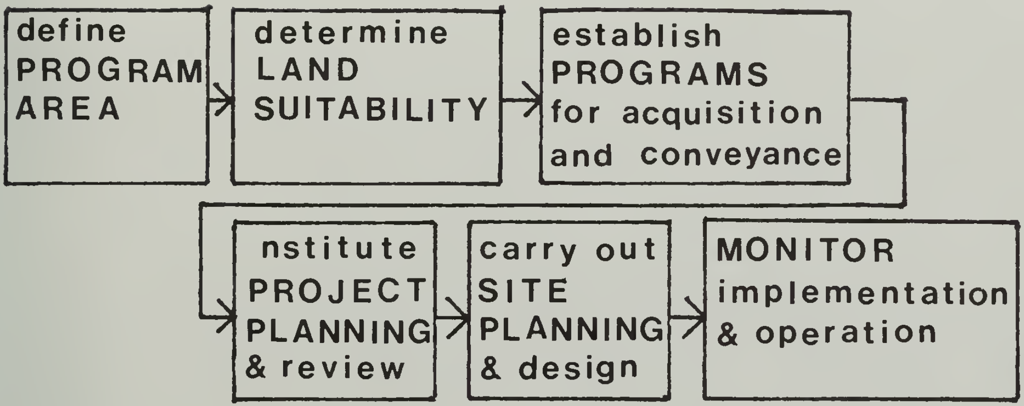


PART B

PROCEDURES

CHAPTER B-I

PROCESS FOR LAND TENURE ADJUSTMENT


define PROGRAM AREA
determine LAND SUITABILITY
establish PROGRAMS for acquisition and conveyance
nstitute PROJECT PLANNING & review
carry out SITE PLANNING & design
MONITOR implementation & operation

Achieving these objectives will require a clearly defined set of actions implemented in sequence to form a coherent managerial process. The basic outline for such a process will be the subject of the present chapter.

The diagram above represents a summary of the process. The task descriptions in this section will follow the titles and sequence of this diagram. Further explanations of the major tasks are included in Chapters B-II through B-V.

PROGRAM AREA

The "program area" is a general region within which land tenure adjustments are to be made. The definition of land tenure adjustment program areas within designated

Factors influencing choice of program area.

resource areas should be a part of the resource management plans prepared by each district. Decisions as to which lands are to be included and their boundaries will be influenced by a variety of factors. Among these will be the multiple use classes established for the area by the California Desert Plan, accessibility, importance of the land for various uses, and proximity to urban areas. Lands already in disorderly patterns of ownership, including checkerboard patterns, with all of the associated management problems discussed in Chapter A-I should be considered first.

One example of such a disorderly land tenure pattern is the program area of the Desert Slope on the eastern side of the San Bernardino Mountains. Because it is a particularly good example of this pattern, and because all of the associated problems are there in abundance, Desert Slope was used as a prototypical program area for purposes of this study. The planning study for that area, as described and illustrated in part D of this report utilizes the full range of analytical procedures required to identify lands best suited for acquisition or for transferral to private management. Throughout the remainder of this report, references will be made to various aspects of the prototype study to illustrate specific procedures.

The Desert Slope area, for all its rugged beauty, is a landscape of confusion, featuring numerous problems that emerge from tangles of public and private ownership. The program area studied is, however, extended far beyond the checkerboard pattern in order to include a land area large enough to offer a considerable variety of options and use possibilities.

"Land use plans shall be developed for the public lands regardless of whether such lands previously have been classified, withdrawn, set aside, or otherwise designated for one or more uses." (FLPMA; Section 202).

Ideally, a program study area is a physiographic unit, such as a watershed. In the desert, however, physiographic boundaries are usually not as clearly defined as in wetter landscapes, and other kinds of boundaries may play more significant roles. In the Desert Slope area, political or jurisdictional boundaries, including those of a National Forest, a National Monument, and a Marine Corps Base, were especially important.

DETERMINING LAND SUITABILITY FOR CHANGE OF TENURE

Factors determining suitability.

Once designated as such, a land tenure adjustment program area becomes one of the "new management initiatives" which "require more detailed plans and will require further environmental assessment." Detailed planning and assessment should begin with a land analysis to identify lands to be designated for future conveyance or acquisition. The factors involved in such an anlysis are competing or conflicting uses, location with respect to existing development, and potential environmental impact. Methods for analyzing these factors and their interactions to determine overall suitabilities for a program area are described in Chapter B-II and illustrated by the Desert Slope example. This analysis can be carried out by the district staff under the direction of a landscape architect or planner, or by a private consultant.

Ideally, the key factors are analyzed and mapped with a high level of sophistication, as was done for the Desert Slope example. This will require the assembling of data that is finer in scale and more precise than that generally provided in the California Desert Plan. In cases where information of this quality cannot be obtained, a less detailed information base can be accurate enough for general area determinations at the large scale.

Lands deemed through this analytical process to be highly suitable for private occupancy and use can then be designated for lease or trade to private groups and individuals. Privately owned lands that are intermixed with public lands (primarily checkerboard or Small Tract holdings), and that emerge from the anlysis as unsuitable for private occupancy and use can be designated for public acquisition. Boundaries of areas designated for change in tenure should be drawn in such a way as to result in large contiguous landscapes under common management. Through this process, over time, the checkerboards can be reassembled into more coherent and manageable land units.

PROGRAMS FOR ACQUISITION AND CONVEYANCE

Acquisition efforts can utilize any or all of the means of acquisition discussed in Chapter B-III. While a compelling argument can be made for outright purchase of indicated lands, it is unlikely that large amounts of money will be available for such a purpose any time soon, unless the Congress itself can be convinced of the importance of acquisition programs. Thus, in the foreseeable future the principal mechanisms for acquisition of land will be tax delinquencies and land exchanges.

Principal mechanisms for acquisition.

As noted in Chapter A-I, the State and local requirements under California law are very similar in principle to those imposed by FLPMA and NEPA. This provides a strong common interest with State and local authorities which could be of particular value in the acquisitions phase of a land tenure adjustment program. If cooperation does not exist, an expression of even tentative Federal interest in an area could excite speculative fever and inflated land values. However, many lands now in private hands have little intrinsic economic value if national, state, and local policies are seriously implemented in concert with one another. Thus, analysis of a potential program area should include consideration of other regulatory tools that may be available in tandem with those of the Bureau. These may include, for example, restrictions on extension by the State or by special districts of utility services, and denial by local building and planning authorities of requests for variances in building and zoning codes in these areas. If strict compliance with regulations is required, there will be very little construction, and therefore little increase in vested interests in the small tracts.

"It must be shown to the satisfaction of the Secretary that the land is to be used for an established or definitely proposed project." (FLPMA: Section 212).

If analysis indicates that land is suitable for conveyance to the public, and a determination is made to proceed with a conveyance program, BLM should annouce its willingness to consider proposals for private uses within these suitable lands that are in accord with stated guidelines, essentially those explained in Chapter B-V.

Three forms of conveyance.

To carry out the objectives of the land tenure adjustment program, three distinctly different forms of conveyance may occur. They are:

1. Lands made available in small parcels for trade to present owners of small (five acre) tracts.
2. Lands made available in large parcels for trade to present owners of large checkerboard areas in the desert, particularly the Southern Pacific Land Company, and to owners of other large private tracts.
3. Lands made available for long term lease.

In the latter two cases, there will be important advatages to BLM in conveying moderate to large size parcels of land (at least 100 acres), to groups or individuals who will act as developers, who in turn may reconvey to other individuals. This will shift most tasks of planning and design to the proposer, and will lessen

The Bureau's role in sensitive development.

BLM's administrative burden by minimizing the number of people the Bureau staff needs to deal with. It also increases the ability of the Bureau to require coherent, unified land planning, particularly with respect to clustered arrangements. If these moderate-sized developments are carefully located in the landscape, and if stretches of open space separate them, their visual and economic effects will not be overwhelming. If designed with sensitivity to the desert environment, they may very well enhance it, both ecologically and visually. Through appropriate organization and staffing (to be discussed shortly) such purposes can be achieved as a regulatory function of the agency at low cost in required staff time. This is an unusual function for the Bureau, but one that adapts to the agency's newly mandated purposes as stated and implied by FLPMA. These include the purpose of retaining Federal ownership while responsibly making the land available to the public for a wide range of uses.

Because of national policies expressed in FLPMA (see Appendix), and for reasons explained in Chapter B-III, fee simple title to desert lands should be made available to private parties only in trade for title to lands presently in private ownership which the Bureau decides to acquire. All other conveyances to private management should be by long term lease.

Lands made available for trade in small parcels present a different and considerably more difficult situation. In these cases, BLM or its designees will have to act as subdivider and will need to carry out detailed land planning. In order to be attractive to potential traders, the resulting parcels will have to accomodate construction of individual cabins or houses, and will have to be well located with respect to access and amenity. To carry out this type of subdivision and development in a manner that follows the general principles of desert adaptation, and at the same time to avoid the problems created by desert subdivision in the past, will be a difficult, though not impossible task for the land planner.

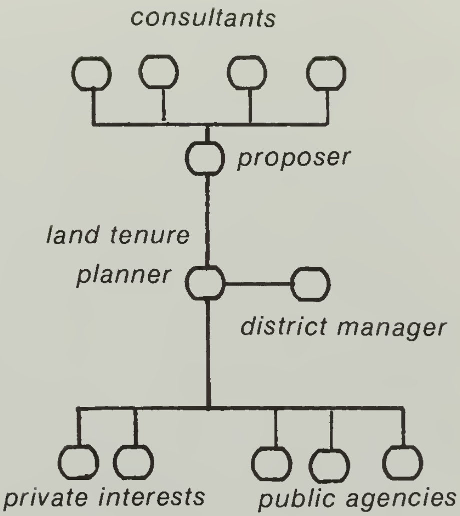
PROJECT PLANNING AND REVIEW

The procedure of leasing or trading land to entities that act as developers and, as such, carry out planning and design, will require that the BLM coordinate project reviews and provide technical advisory and consultation services. In order to simplify the plan review process as much as possible, to avoid overlapping and redundancy among agencies, and to expedite matters in general, a relatively simple organizational format centering on one highly qualified individual staff member is recommended. This staff member, who might be called the land tenure planner, will work with the proposer on one hand and with other public agencies and concerned citizens on the other.

Ideally, the person filling this role will have specialized training in ecological land planning and design. It will be his responsibility to work directly with the proposer, providing consultation and advice concerning the quality and character of development required by BLM. His influence upon the plan can be great, if he is delegated adequate authority.

On matters involving other levels and units of government, the land tenure planner will act as liaison between proposer and the other agencies. This job will be facilitated if a review committee composed of a staff member with decision making authority from each of these agencies is formed. The likely composition of such a group is explained in Chapter B-IV. The review process will be hastened and made far less costly for all concerned if this committee can meet regularly and if decisions as to approval or disapproval for less complicated situations can be rendered at the periodic review meetings.

Proposed new private uses in the desert will generally be of concern to local residents. In most cases it will be important to have available suitable media for



Special staff skills needed.

expressions of opinion by concerned citizens. These could include individual interviews, public hearings, or formation of a Municipal Advisory Council (MAC) in unincorporated where populations of significant size already exist.

SITE PLANNING AND DESIGN

". . . the public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resources, and archeological values. . ." (FLPMA; Section 102(a)).

Under this pattern of organization, site planning and design are the responsibility of the proposer, while the land tenure planner will be charged with guiding and reviewing these efforts in such a way as to insure that the results are in accord with national policies for public lands. No explicit set of rules or standards can accomplish this. It can best be achieved by responsible and creative interaction between the BLM and the proposer, both of whom should ideally be represented by highly qualified planning and design professionals. The principles stated in Chapter B-V and part C of this report should serve as guides and general criteria for planning and design. However, rigid rules and standards would be inappropriate in this situation, because they could seriously limit planning options, and therefore would not be workable. Competent, informed professional judgement is most desirable, through hired consultants if not through inhouse BLM staff.

The requirement that planning and environmental assessment processes be combined should apply as much to the private proposer as to the BLM. Thus, ecological analysis should in all cases be an integral part of the site planning and design process.

While leaving the form and content of site plan and design to the creative interaction of planner and proposer, BLM should require certain elements and conditions. The agency should require, for example, that the proposer rely on the services of specific types of planning and design professionals, including architects and landscape architects. As a further refinement, the District Manager may wish to require the proposer to select a consultant from a limited list of individuals or firms that have demonstrated their ability to plan and design with sensitivity to the desert environment and to the regulations and the national policy requirements of the Bureau. All work presented by the proposer to BLM should bear the responsible professional endorsement of the consultant.

This work should include, as a minimum, the following elements:

1. Resource analysis, an analytical study of the local landscape to determine the best sites for proposed uses. In general, this is similar to the suitability analysis described in Chapter B-II, carried out at a smaller scale with finer detail.

2. Site plan, showing the precise location of all uses, buildings, and other site improvements.

3. Landscape plans, showing planting and grading.

4. Energy budget, with estimates of quantities of energy needed for various purposes and the sources from which it will be obtained. This should include an explanation of energy flow through the community and the various ways of guiding and controlling it. Energy utilization should meet the requirements of the State Energy Commission.

5. Water budget, with estimates of quantities of water needed for various purposes and the sources from which it will be obtained. The

water budget should show how the water management techniques described in Chapter B-V are utilized and how the regional water regime is altered by the development, especially with respect to ground water supply and quality.

6. Architectural design, with particular emphasis on the adaptation of forms to the desert environment.

Each of these elements incorporates some predictions of environmental impact. Together, they should be orgainzed to constitute a complete combination of plan and environmental impact report.

MANAGEMENT AND MONITORING OF LEASES

Under this approach, when a lease for private management is in effect, and after an approved plan has been implemented, the land will still be federally owned and therefore under the jurisdiction of BLM. This places the Bureau in a somewhat novel land tenure management situation — controlling developed residential, commercial and other "urban" types of use through long term lease. This does however, fit the "multiple use and sustained yield" intent of FLPMA; furthermore, there is ample precedent for long term leasing in the Bureau's grazing and mineral lease programs. A comparison may be also drawn with other federal programs such as national park hotel and commercial concessions, and U. S. Forest Service recreational housing tracts. The Bureau could be well advised to study the experience of these other agencies in proceding to implement a multiple use leasing program, perhaps through establishing a task force of staff seconded from the sister agencies. The experience of certain state agencies may also be of value in such an effort.

After developing an appropriate leasing program, the Bureau will have a continuing responsibility to see that effective management is maintained. This can be achieved by techniques such as required annual inspections and reports, and periodic checks to see that such reports are accurately prepared. Work of this type, as well as the Bureau's efforts in the preparation, review, and approval of the initial proposal and plan may be financed through project fees and leaseholder fees.

Annual leaseholder reports would, among other things, provide an assessment of actual environmental impacts to determine if they are indeed the same as the predicted environmental impacts. So the reports should focus primarily on ecological changes within and around the development, on water usage, on productivity and on changes in the human needs and uses of the areas. When changes occur that are not within limits originally predicted, then both the lessee and BLM should be concerned to find out why and, if necessary to undertake corrective measures.

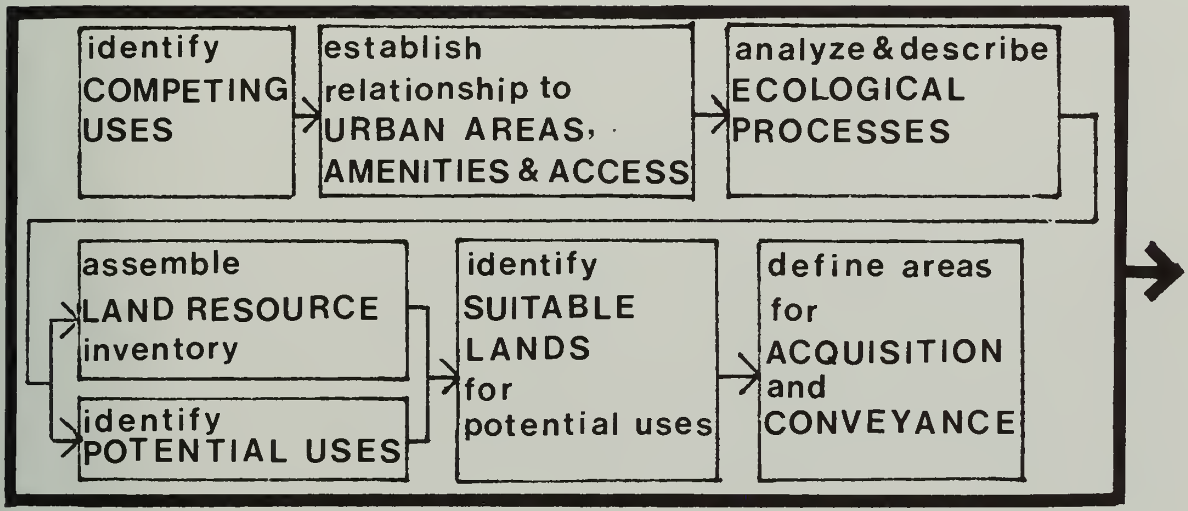
This tactical approach results in a great deal of intensive, detailed management in accordance with FLPMA and other reqirements, with no additional direct cost to the Bureau. It should also result in a growing collection of knowledge concerning human adaptation to desert conditions, and a growing experience of how to manage this form of development in arid lands. The Bureau of Land Management is an appropriate national agency and storehouse for that experience.

". . . it is the policy of the United States that — (1) the public lands be retained in Federal ownership. . ." (FLPMA Section 102(a)).

". . . (In managing the public lands), the Secretary shall regulate, through easements, permits, leases, licenses, published rules, or other instruments. . . as the Secretary deems appropriate, the use, occupancy, and development of the public lands , including, but not limited to, long-term leases . . to permit individual to utilize public lands for habitation, cultivation, and the development of small trade or manufacturing concerns." (FLPMA; Section 302(b)).

DETERMINATION OF LAND SUITABILITY

CHAPTER B·II


identify COMPETING USES
establish relationship to URBAN AREAS, AMENITIES & ACCESS
analyze & describe ECOLOGICAL PROCESSES
assemble LAND RESOURCE inventory
identify POTENTIAL USES
identify SUITABLE LANDS for potential uses
define areas for ACQUISITION and CONVEYANCE

The success of the entire land tenure adjustment process will depend heavily on correct selection of lands to work with. According to FLPMA, the lands to be made available for public management through the lands and realty program are specifically those "public lands found *suitable* for the legitimate needs of the private sector" (emphasis supplied). The act goes on to list a number of specific criteria for selection of lands to be sold, acquired, or exchanged. The sections containing these criteria are included in the Appendix of this report. The present chapter will describe a larger range of factors to be considered in meeting the broader policies of FLPMA.

FLPMA;Section 202

COMPETING USES

The first consideration is competing uses. Governmental uses take precedence over private uses. Land which is in public use or which by virtue of its location or natural character is considered important for present or future public purpose, is therefore considered unsuitable for private use. Areas of historical or cultural importance, high resource value, unique natural character and unusual hazards are included here.

Historical and Cultural Values

Important historical and archeological areas are protected by federal legislation. The Antiquities Act of 1906 prohibits the removal or disturbance of any "historic or prehistoric ruin or monument" or "object of antiquity" on federal land without permission of the Secretary of the Department having jurisdiction over that land. The historic Sites Act of 1935 and the National Historic Presentation Act of 1966 further require an investigation of any land being considered for use or sale to identify any sites, buildings, structures, or objects of historical significance. If any of these are found, they are to be preserved and the proposed use denied on the site where they are located.

In parts of the California Desert, remnants of Native American habitation are of particular concern. In some cases, these are important cultural landmarks. Examples are petroglyphs and petrographs. In other cases, potentially important information may be gained by future archeological investigation. Some sites, on the other hand, have little importance and may be entirely compatible with human use. It's worth noting here that some of the areas best suited for ecologically sensitive use will naturally have been identified and occupied by

Native Americans. Compatible uses, perhaps incorporating display of old relics into new community uses, may be acceptable in some cases, especially if Native American groups are involved in the proposed new development.

Many important historical and archeological sites have been identified and mapped as part of the Desert Planning Program. However, a great many others very likely remain unknown. Therefore, an investigation should be carried out to identify cultural, historical or archeological sites within each land tenure adjustment program area. When such sites are found, specialists in the appropriate field should be consulted to determine what, if any, protective measures are needed.

Resource Value

Under the provisions of FLPMA, lands with mineral value may now be conveyed to private use or ownership. Conveyances of title, however, other than those involving land exchange, reserve minerals in these lands to the federal government.

At the same time FLPMA reinforces the Mining and Minerals Policy Act of 1970 in recognizing the national need for domestic sources of minerals. So where mineral potentials exist within a program area, a careful analysis will be needed to determine their compatibility with other uses. Where mining claims already exist, their value and validity will have to be determined. Especially in cases where claims are contested, this process can result in years of delay.

"The public lands will be managed in a manner which recognizes the Nation's need for domestic sources of materials." (FLPMA; Section 102).

FLPMA: Section 603

Unique Natural Character

FLPMA; Section 601

Areas designated for wilderness preservation are clearly unsuitable for private use. Under FLPMA, roadless areas of 5,000 or more acres having wilderness qualitites are to be subjected to a fifteen year review period for possible designation as wilderness areas. During this review period, these lands are to be managed in ways that will preserve their natural qualitites. These lands are, therefore, effectively excluded from conveyance programs until after such review.

Apart from such designated areas, important wildlife habitats exist in some parts of the desert. Where rare or endangered species of fish, plants or wildlife are involved, protection is required by the Endangered Species Act of 1973. In other cases, habitat lands require individual evaluation. The Sikes Act of 1960 makes provision for cooperative agreements with states for habitat development and management.

Unusual Hazards

Certain desert lands feature particular hazards that require particular attention. Outstanding among these are earthquake faults and floodplains.

Many of the faults that lace parts of the desert are potentially active. It is important to locate and map them in a program area before making land use decisions. While it is not feasible to locate all development beyond range of seismic stress, areas of particular hazard can be avoided. These include locations directly above fault lines and those with soft soils that magnify earth movements.

Floodplains present particular hazards in the desert due to the phenomenon of flash flooding. The Executive Order on Floodplain Management of 1977 (E.O. 11988) specifically directs federal agencies to minimize risks of flood loss and potential impact on health, safety and welfare. In general, floodplains should be retained under federal management, and structural development or any form of intensive use avoided.

RELATION TO URBAN AREAS

The second consideration is location with respect to urban areas, existing areas of private use, recreational or scenic amenities and transportation routes. Lands which are not in reasonable proximity to any of these can generally be considered inappropriate for private use. The possibility of colonizing new areas should not be foreclosed, however, if it would "serve the national interest." It is conceivable, for example, that an individual or group could formally propose a program of use that could include a range of management and "caretaking" functions for an area of desert that is distant from existing uses. This could be of direct institutional benefit to the Bureau, and the caretaking responsibilities could be spelled out as a condition of lease or any other form of conveyance. Some individual desert dwellers now regard themselves informally as caretakers of their particular area; sensitive design and integration with the landscape could make such uses more compatible and more beneficial. Normally, there will be little demand for such land, and therefore the issue of its suitability will not often arise. But the possibility of this option should be kept open.

On the other hand, as mentioned before, there have been a number of instances in the California desert of development on locationally unsuitable land, which resulted in severe alteration of the landscape, sometimes with no compensating human use. Such uses are to be avoided, and existing ones mitigated by regulation or removal where possible. Within those lands that are unencumbered by existing or potential public use, and which are so located with respect to existing use patterns as to be attractive for private use, the major concerns are ecological.

ECOLOGICAL SUITABILITY

". . . the California desert environment is a total ecosystem that is extremely fragile, easily scarred, and slowly healed" (FLPMA; Section 601(a) (2)).

The natural landscape varies enormously in its capacity for accepting and accomodating human use. In some places, human activity can be integrated with natural processes in a way that is not disruptive, and that can be beneficial to them. In other places human activities can be devastating in their effects on the natural environment with results that are destructive for both human and natural systems. This is particularly true in the desert.

Thus the identification of ecologically suitable sites is an essential prerequisite to the establishment of private use in the California desert. The analytical process for determining ecological suitability can be carried out in a series of steps by applying land resource data that is already generally available. The Desert Slope case study illustrates such a process.

While the data collected and assembled for the Desert Slope is more detailed and extensive than that which will usually be available for land tenure decisions, it is not unusual in type, organization, and techniques for application. So it will be useful to refer to the Desert Slope project occasionally for clarification while reading this chapter.

Basic ecological processes.

The assessment of ecological suitability begins with the analysis and description of basic ecological processes. In the desert situation, these include the flow of water, the movement of soils, and the pattern of plant communities. These form the functional framework within which human uses of the land must operate. It is therefore important to analyze and describe them not just in terms of form but also in terms of function. This is best done by developing simple graphic and quantitative models like those shown as part of the Desert Slope example.

Once these basic ecological processes have been analyzed, then their geographic distribution can be described. This description generally takes the form of a set of maps called the land resource inventory. These are drawn to the same scale so they can later be overlaid to analyze interactions of different factors. In addition to the geographic distribution of hydrological features, soils and plant and animal communities, the inventory usually also includes topography and visual quality. In some specific situations, other characteristics, such as geological structure or microclimatic patterns might also assume importance.

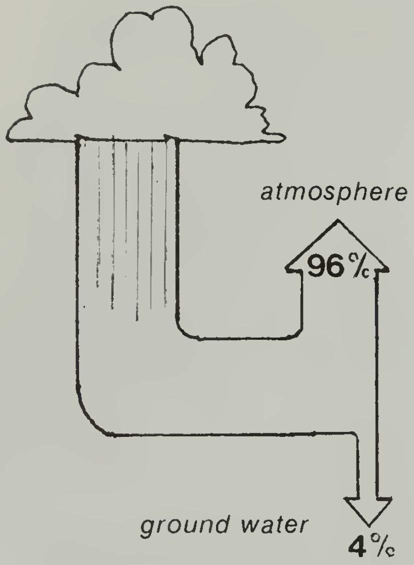
Elements of the land resource inventory.

Hydrology

Since the supply of water is usually the limiting factor in desert ecosystems, the analysis and mapping of the hydrological pattern of overland flow is the first consideration. Because virtually any kind of activity will be dependent on a supply of water, the relative locations of canyons, washes and channels is of critical concern in locating any human activity. As explained in the next chapter B-V, there are a great many ways of maximizing the use of even a meagre flow of water. But where there is no water on or under the land, there can be little or no life.

At the same time, to preserve the integrity of the larger system, it is important that human activities not disrupt the flow of water. Since there is rarely a surplus or margin of safety, any interruption of the flow is likely to seriously affect communities of plants and animals downstream.

Major hydrological factors.



At the same time, it is likely to diminish the underground supply. This is a serious problem since, in desert conditions, the replenishment of ground water is slow and sporadic at best. In the Desert Slope area, for example, it is estimated that only about 3.8% of the precipitation eventually finds its way into the aquifers. Most of the rest is evaporated along the way. This presents both a limitation and an opportunity for human use. It is often possible to make use of water that would otherwise be lost to evaporation. In some cases, by using this water and then returning it to the system, it is even possible to increse the downstream flow.

The second hydrological factor of major importance is the location and extent of ground water basins. Especially in lower lying areas, the integrity of desert ecosystems is dependent on the water in ground water basins. Both the quality and the quantity of these can be easily diminished by human activity. And once diminished, due to the slow rate of flow, recovery takes a very long time.

In the case of Desert Slope, an analysis of the ground water basins shown on the geohydrology map indicated that four of the eight basins had seriously impaired water quality, probably due to human influences. The analysis also showed that at least two basins have serious annual deficits, but that two others have surpluses which can be made available for human use.

Thus, an analysis of the overall system of waterflow in the Desert Slope program area suggests that the most suitable locations for human habitation are in the upper foothills, where water can be used before most of it evaporates, and specifically in the parts of these areas that drain into the Johnson and Pipes basins, which presently have water surpluses.

Unfortunately, precise ground water data are usually not easily available. However, reasonably accurate estimates can often be made even from scanty data.

SOILS

Due to the relatively slow pace of natural processes in the desert, soils usually present serious limitations for human use. They are often weak in structure and lacking in organic materials. And once soils are damaged or lost, the process of recovery or replacement is so slow that the loss can be considered permanent in the perspective of human time scales.

Most critical soil characteristics.

In most cases, the most critical soil characteristics are bearing capacity, fertility, and runoff potential. For most areas of the United States, the Soil Conservation Service has carried out soil surveys which classify soils by type and by capability categories which include these three characteristics.

Bearing capacity is important where structural improvements are considered. Usually these include roads and small buildings. Large structures with massive foundations are generally inappropriate for desert conditions for other reasons.

Fertility is an important consideration wherever activities under consideration involve the cultivation of plants for agricultural, ornamental or other purposes. These will include virtually all types of part-time and permanent settlement.

The soils of the California Desert are generally highly susceptible to erosion, low in nutrient content, and have poor water holding capacity. This means they are unsuitable for most conventional forms of agriculture which involve large-scale cultivation, irrigation and fertilizers. Such agriculture, being dependent on massive importation of water and nutrients is certain to be unstable and impermanent. And the imported materials would be severely damaging to desert ecosystems, especially since there is no way of confining them to the boundaries of the agricultural fields for which they are imported. On the other hand, desert soils can support some smaller scale forms of agriculture, especially those that are adaptive to desert conditions and resources. These adaptive forms will be described in Chapter B-V.

Vegetation

Most common plant associations.

The most common plant associations in the California Desert are:

Pinyon/Juniper Woodland,
Semi-Desert Chaparral,
Joshua Tree Woodland,
Creosote Scrub, and,
Salt Bush.

By comparison with plant communities of wetter climates, all of these are sensitive and limited in their capacities to tolerate human use. But levels of sensitivity are relative, and each community has its own particular limitations. In some situations, it is best to entirely avoid disturbance of the more sensitive communities. In other situations, careful design can mitigate damage, and sometimes the human presence can even improve conditions for plants and enrich the communities.

Analysis and mapping of vegetation patterns on any land being considered for private use is important to the preservation of desert ecosystems. This is true not only because of the values and functional roles of the plants themselves, but also because of the conditions they reflect. Plant communities can be viewed as responses to varying conditions of soil and microclimate. Thus, by analyzing plant communities, conditions of soil quality, precipitation and temperature can be estimated with resonable accuracy. Since wildlife habitats are also closely correlated with plant communities, the analysis of vegetation patterns can give a reasonably reliable indication of animal species present in an area.

On a larger scale, plant associations correspond closely to zones of topographic elevation. The following discussion of the major desert associations will begin with those of higher elevations and proceed to those of the lowest areas.

Pinyon-Juniper Woodland

This association is found in the foothills of mountain ranges bordering the desert, normally just below the yellow pine belt. Because of its higher elevation, this is the most productive and diverse of desert-related plant and animal communities. Its value as wildlife habitat is high, and it usually serves an important watershed function in relation to lowerlying areas.

In most situations, the Pinyon-Juniper Woodland is quick to recover after damage. But in marginal areas, it has sometimes been replaced after fire or other disturbances by the chaparral association.

In general, the value of this association for wildlife habitat and watershed argues against its being widely disturbed for private uses. On the other hand, it is entirely suitable for dispersed recreational uses like hiking. And the beauty and protective quality of the plants offer an attractive environment for human habitation. Small developments, if located and designed with care and sensitivity to the landscape, can be compatible with the Pinyon-Juniper Woodland.

Semi-Desert Chaparral

Similar in character to the chaparral of semi-arid regions, but sparser in density, this association features a range of small and large shrubs. It grows on hillsides, usually on rugged terrain at the same elevations as the Pinyon-Juniper Woodland and slightly lower. The chaparral provides important wildlife habitat and watershed areas, though it is less productive and therefore less important in these respects than the Pinyon-Juniper Woodland.

Considering the danger of fire, the problems of erosion where cover is removed, and its general lack of attractiveness as a setting for human activity, the chaparral is generally best left undisturbed. Where attractive conditions do exist in chaparral communities, very small areas of development can be compatible.

Joshua Tree Woodland

Joshua trees grow in the higher desert areas, joining the California Juniper in their upper reaches and the Creosote Bush in lower areas. They do not grow where rainfall drops to less than six inches per year.

Joshua trees are tough and resilient with a root structure that limits itself to a small area, and are thus not highly sensitive to nearby human use and development. They also offer some visual cover and aesthetic attraction for human use. Normally, in the zones that they occupy, most of the rainfall percolates to underground storage, rather than flowing to other areas.

These factors combine to make the Joshua Tree Woodland an association that is relatively tolerant of human use. However, a number of desert wildlife species are dependent on the Joshua trees for food or cover, and therefore any development plan should provide for their protection.

Creosote Scrub

The Creosote Bush covers large areas of the lower alluvial fans and desert floor where few other plants survive. In the lower, dryer areas, it is joined only by the Burroweed to form a sparsely covered and relatively featureless landscape. The related wildlife community, while not a rich one, is entirely dependent on these two plants.

The Creosote Bush is also the sole source of support for a variety of desert annuals that stump sprout from its interior wood after it dies, forming a flowering circle called a creosote ring. Some of these annuals have coevolved with the Creosote and are endemic to specific microclimates.

Due to its sensitivity and slowness in recovering from disturbance, as well as its general lack of attractiveness for human use, the Creosote Scrub is not a promissing environment for private tenure.

Salt Bush

This association is composed of plants with high tolerance for saline conditions and is found in the alkali sinks where desert runoff accumulates and much of the water evaporates, leaving high salt concentrations. Vegetation in these areas is extremely sparse and productivity is low.

The only human activity often found in salt bush areas is off-road vehicle use and, in general, this does not seem incompatible. In most cases, the plants seem little affected by the activity.

The accompanying chart summarizes the values and sensitivities of these five plant associations and gives an indication of their adaptability to human activity. However, these general conclusions will not apply to every specific situation. Wherever private tenure is under serious consideration, a local study of plant associations should be carried out and an anlysis developed for compatibility with the particular activity under consideration.

Topography

Important topographic factors.

Three topographic characteristics are particularly important in assessing land suitability for human use in the desert. These are elevation, slope gradient, and slope aspect.

Elevation is important not so much for its own sake as for its relationship with other qualitites that affect land use. For example, in desert conditions, the higher the elevation, the more rainfall there is likely to be, and the cooler the average temperature. As pointed out in the preceding section, the more amenable plant associations occur in the higher areas.

The slope gradient limits the range of human activities that can reasonably be carried on in a particular place and determines the amount of disturbance of the existing landscape required where the land is to be reshaped to fit human activity. In general, the steeper the slope, the greater the disturbance. The importance of slope gradients varies according to local conditions. In areas of particularly rugged terrain or where soils are thin or highly erodible, they can be of critical importance.

In some cases, construction systems can be applied that not only cause little damage to steeper slopes, but even turn them into a positive advantage. This is the case with subterranean building and with the cliff dwellings of some American Indians.

As a very general but widely accepted rule of thumb, however, we can say that slopes of between two and ten percent are easily used and developed. Those between ten and twenty-five percent are more difficult but still feasible, and often offer advantages in terms of views and solar exposure. And slopes of over twenty-five percent require major alterations of the landscape for development.

Slope aspect, or the compass direction to which the land is oriented, is important primarily for reasons of solar exposure. Both north and south aspects can offer considerable advantages. North facing slopes are coolest and hold moisture better than any others. For this reason, they can be best in the hottest parts of the desert.

South facing slopes, on the other hand, offer the greatest opportunities for flexibility in either admitting or shutting out solar radiation. Thus, they are best for use of both active and passive solar heating and cooling systems.

East and west exposures are subject to harsh and virtually uncontrollable levels of radiation at certain times of day, while having none to offer at others, and are therefore, in most situations, the least desirable aspects.

Visual Quality

The scenic character of the landscape is not, strictly speaking, an ecological matter. But because it involves so many ecological factors, it will be considered along with them.

The consideration of visual quality is important for a number of reasons. A great many desert visitors go there mostly for a visual experience. The desert offers sweeping views, a sense of vastness and an aura of purity and simplicity that can be enormously appealing. Some parts of it, like the Desert Slope, feature fascinating visual contrasts as demonstrated by the great demand for parcels made available in that area under the Small Tract Act of 1938. That these visual qualities are highly susceptible to interruption and destruction by poorly considered development is evident from the results of that disposal program. Landscape blight of this sort can be avoided by careful analysis of the visual character of the landscape and by locating development where it fits that character. In some cases, this may be a matter of locating human activities where they will not be seen by most desert visitors, thus preserving the impression of a purely natural landscape. In others, the work of the human hand might be placed so as to complement, and even enhance the natural setting.

BLM's Visual Resource Management (VRM) system, as described in BLM manual 8400, provides a process for analyzing the visual character of the landscape and determining visually suitable locations for given management activities. Any area where land tenure adjustment is contemplated should be anlyzed and classified according in accordance with the VRM process.

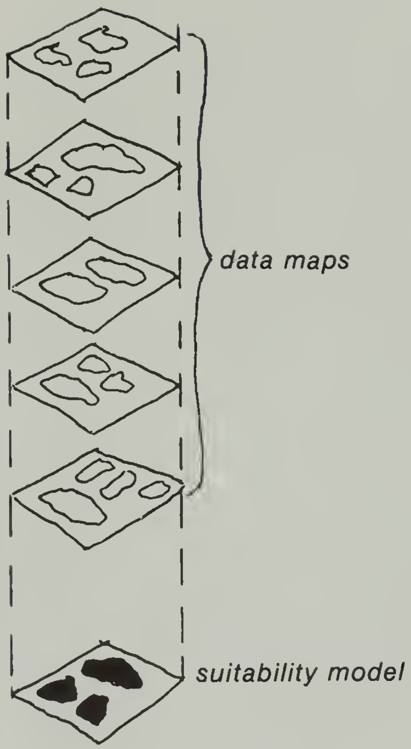
In brief, this process calls for assessing and mapping the scenic quality, visual sensitivity and distance zones of the land area (in this case, a Program Area) in question. These determinations are then combined to subdivide the landscape into five managment classes, which may be summarized as follows:

Visual resource management classes.

Class I	To be preserved in an essentially natural state.
Class II	Changes may be made, but should not be evident.
Class III	Changes may be evident, but should be subordinate to the existing landscape.
Class IV	Changes may be dominant features in the landscape, but should be in harmony with the visual character of the existing landscape.

Class V	Change is desirable to add visual contrast; usually, this applies to severely disturbed areas.

In general, land in classes IV and V will be considered most suitable for human settlement or intensive recreational use. Class III land is suitable in some cases with careful location and design.



COMPOSITE SUITABILITY

By combining the assessments of these five basic components of desert landscape suitability, it is possible to arrive at an overall or composite suitability determination. This is most easily accomplished by mapping all five factors at the same scale and then overlaying the maps to delineate areas sharing certain combinations of characteristics. Areas most suitable for development will be those sharing the most suitable characteristics in each category. Based on the preceding discussion, these can be summarized as follows:

Hydrology	• Adjacent to a wash or channel. • Over an aquifer with a net surplus and high quality.
Soils	• High bearing capacity. • High fertility. • High permeability
Vegetation	• Joshua Tree Woodland
Topography	• Under 25 percent slope.
Visual Quality	• Class IV or V.

In practice, land areas sharing this ideal combination of characteristics will be relatively few, and many areas having one or more less-than-ideal characteristics may be entirely appropriate for the contemplated use. In these cases, decisions concerning land suitability will depend on local conditions, on the amount of land available, on the presence of overriding factors, and on other considerations. Prediction of environmental impacts will give a reasonable basis for decisions.

By overlaying the data maps that comprise the land resource inventory, lands having any combination of characteristics can be identified. Based on the combination of characteristics found there, the potential impacts of given types of development can be predicted. For example, the construction of buildings on a piece of land with highly permeable soil, an average slope gradient of 30 percent, and a plant cover of chaparral will probably result in a lessening of the flow of water into the underground supply, an increase in erosion, and some loss of wildlife population. These may or may not be acceptable consequences, depending on the extent of the project and other contemplated development, and on the location and goals for the area.

Each case should be considered individually, following the general guidelines given above. The Desert Slope example illustrates the composite suitability mapping process, and the resulting suitability determination. In this case, the total study area is subdivided into:

- Lands deemed unsuitable for private use which were previously disposed of;

- Lands deemed suitable for private use which were previously disposed of; and

- Lands deemed unsuitable for private use which are still under BLM tenure;

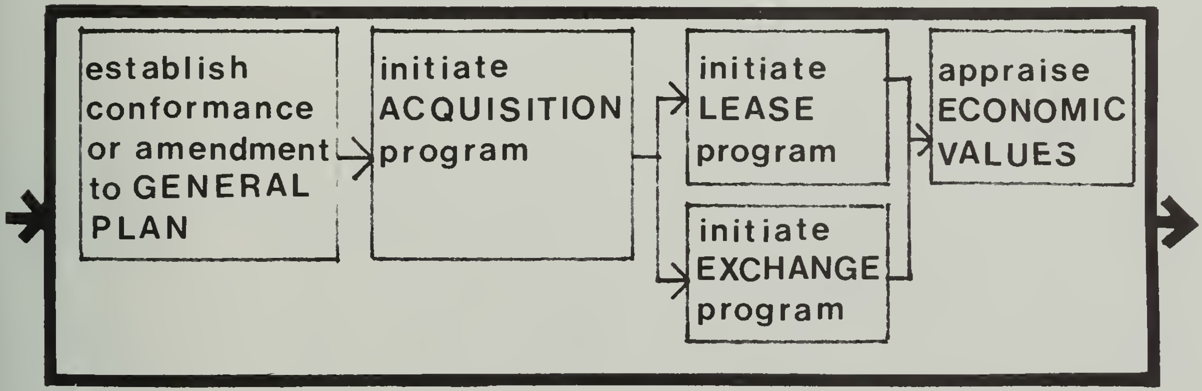
- Lands deemed suitable for private use which are still under BLM tenure;

The composite suitability map provides a guide for a long-term program of land tenure adjustment, calling for lands in the first category to eventually be reacquired, lands in the second and third categories to be left in their present status, and lands in the fourth category to be made available for private tenure.

One important difference between this map and the types of maps used in the past to delineate areas for tenure change is immediately obvious. This is the irregular, organic character of the lines of demarcation, reflecting their origins in the natural characteristics of the landscape. In the past, such boundaries were invariably straight, meeting at right angles and forming large squares, or rectangular blocks of land. This geometric pattern reflected the fact that the areas were determined by the abstract mathematics of the surveying grid, rather than by any real land features. This is not a superficial or cosmetic difference, but one that manifests a different attitude toward the land, a new concern and sensitivity that is in the spirit of emerging public policies. An analogous situation, with basically the same origin in geometric covenience, exists in the Bureau's outer continental shelf oil leasing program, where the square grid of lease tracts bears no relationship to underlying geology.

PROGRAMS FOR ACQUISITION AND CONVEYANCE

CHAPTER B-III


establish conformance or amendment to GENERAL PLAN
initiate ACQUISITION program
initiate LEASE program
initiate EXCHANGE program
appraise ECONOMIC VALUES

Once lands suitable for change in tenure have been designated and mapped, the next step is to establish programs to effectuate the change. This chapter will examine the institutional processes by which control of land for private use can be turned over to private interests, and land which is in private hands can be assembled for public use if such use can be shown to be necessary or in the national interest.

The previous systems by which the BLM disposed of land to private interests have resulted in problems of disuse, unlawful enclosure and administrative complexity as described in previous sections. To avoid such difficulties in the future it will be necessary to build in mechanisms by which the private land holders may be assured of protection of their rights and, at the same time, be stimulated to use the land in ways that will not be detrimental to the environment. In the light of past experience, merely releasing the property and relying upon local land use controls for protection is not adequate.

LOCAL GOVERNMENT

"Before the land may be disposed of under this Act it must be shown. . . that for proposals of over 640 acres comprehensive land use plans and zoning regulations applicable to the area in which the public lands to be disposed of are located have been adopted by the appropriate State or local authority." (Recreation and Public Purposes Act of 1926, as amended by FLPMA; Section 212).

All private use of land in the California Desert is subject to review, and generally to the regulation of local government. The responsibility for dealing with subdivision and zoning in California rests with County government unless the area is within an incorporated city, in which case city government assumes the authority. In either case such regulations as may be passed are based upon the so-called "police power" which is granted to local government by the appropriate State enabling legislation. "Police power" is the general term for the authority by which the actions of individuals are subject to regulation by government in order to protect the public health, safety and welfare. Police power may not be used to take an individual's property, but it is the basis upon which limitations on the use of property may be imposed. Such limitations include the location or design of buildings and the use of property, but the limits cannot be so strict as to prevent the use of the property altogether, and they may be imposed only to protect health, safety and welfare in a relatively restricted manner. They cannot be arbitrary and they are typically not completely effective in insuring good design sensitivity or regard for amenities. Recognition of this fact is the basis for the necessity of BLM assuming a strong position in requiring development or use conditions to be accepted at the time of land conveyance. Local government is legally constrained in the controls it can impose upon development after such conveyance. The BLM is empowered, indeed is required, to impose needed controls, under direction of FLPMA Sec. 208, together with a variety of policies which proclaim the importance of, for instance, protection of "scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values." This is especially important in the fragile California Desert ecosystem.

LAND CONVEYANCE

It is possible for BLM to lease land to individuals or groups with appropriate controls which will protect the environment. In cases where the sale or trade of land is indicated, conditions on future use of the land may be imposed through devices such as easements, or deed restrictions at the time the property is offered for sale, in order to shape future private development in a positive way. Thus, the BLM can strongly supplement the powers of local government in dealing with private interests.

Of the two methods, leasing offers stronger control, because it retains the land in public ownership, subject to the termination of the lease if conditions are not met. Leasing land to "permit individuals to utilize public lands for habitation, cultivation, and the development of small trade or manufacturing concerns" is authorized in Section 302(b) of FLPMA. It should be possible to protect the public interest by drafting lease agreements which define the scope and nature of development, the design of improvements, the terms of use including provision for the protection of natural features and wildlife habitats, and the conditions for continued maintenance of the property, subject to termination of the lease.

Fees should be set on the basis of value to the private user as established by standard appraisal practice. They should include reimbursement for costs borne by BLM and should generate revenue to be used in other acquisition or management activity. Depending upon the nature of the use and the level of investment of the private user, a lease might be negotiated which would be relatively long term (i.e., many years), and provisions could be included for the renewal of the agreement at the option of the user and the BLM. A significant feature of a lease would be that it would be attractive to a potential user of the land and it would be of no use to someone interested in the speculative holding of property for future resale. This would have the effect of stimulating and encouraging actual private use of the desert environment for positive purposes.

In view of the huge number of desert parcels already being held for what are apparently nothing more than speculative purposes, it seems unlikely that owners of existing lots would be adversely affected by a new leasing program. There is a glut of nearly useless lots on the market, and the fragmentation of public and private ownership resulting from past disposal of small parcels effectively prevents the private assembly of land into larger units. Thus, a program for the lease of larger holdings for purposes other than dispersed structures would pose no competition to existing small scale speculative holdings.

ACQUISITION

The large number of small private parcels may be viewed as an opportunity as well as a problem. The continuing weak market for resale of those holdings makes the prospect for large speculative gain unlikely for current owners. Indeed many such lots end up in the hands of local government as a result of nonpayment of property taxes, because some private owners see so little potential for either use or sale. This may turn out to be of assistance for the BLM if it undertakes a process of reacquiring land for public use, and assembly of larger parcels for new private development. Contact should be made through the local planning agency with the County Tax Collector so that BLM is informed of tax delinquent parcels in a timely manner and a process established by which land in default can be returned to Federal ownership.

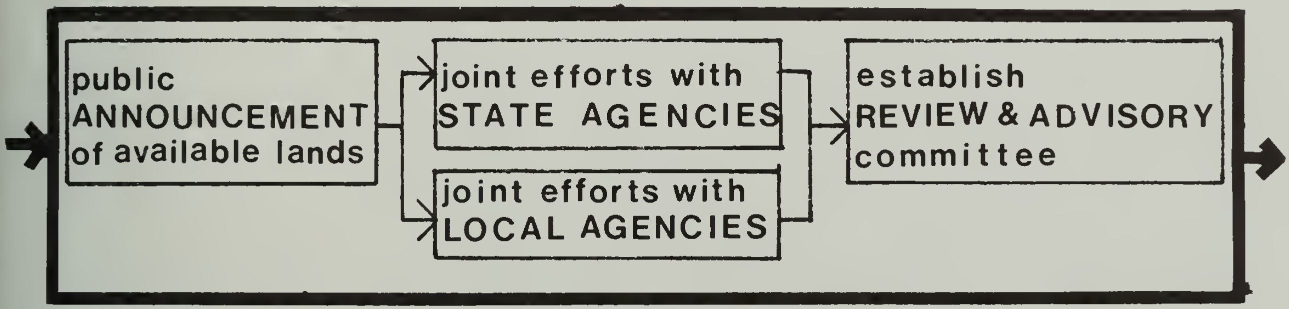
The acquisition of property from private owners will be of considerable importance in areas where it is necessary to do so in order to protect public resources. Where land unsuitable for development and private use has already been turned over to private owner, the BLM will probably find it advantageous to assume the role of land broker, offering owners of property in unsuitable areas the opportunity of "trading up" into developable sites in areas which can bear the impact of development, and which can offer greater potential for use. It would be necesary for the Bureau to develop a trading system to implement such a process. The benefit to private owners would be in gaining access to greater utilization of desert resources, while unburdening themselves of unsuitable and largely unsaleable sites. This is a highly positive economic trade, so on balance the sale or trade of the new properties would generate revenues which could be used by the Bureau to acquire additional property. Owners of isolated parcels should not expect to negotiate trades on an even basis. However, large land holders, such as the Southen Pacific Land Company, would benefit from acquisition of parcels in developable areas while divesting themselves of large scale holding of limited potential.

If legislative or institutional restraints limit the effectiveness of the BLM as a land broker, another alternative may be explored. Many public interest groups express concern for the desert environment. They could be encouraged to create a nonprofit private organization which could carry out the land trade functions described above. Such a group can be thought of as a "desert conservancy" organization, by analogy with the similar purposes of the Nature Conservancy, which specializes in acquisition of lands having unique natural values. The Desert Conservancy may equally well consider appropriate, sensitive human uses to be within their scope of purpose. It could serve or include public interest groups as well as private interests from the various user groups in the desert area. It would have the advantage of being able to identify areas of critical concern with the assistance of the extensive BLM planning information developed in the California Desert Study, and it could probably move ahead more quickly than could a governmental agency, when attempting to respond to changing local conditions and development proposals. It would be necessary for the BLM to carefully monitor such an operation to ensure that public goals are adequately recognized.

It is not likely that such activity will unduly influence the real estate market. Acquisition by BLM of private property will not unduly restrict the supply of parcels which private individuals will hold in the desert. The Stanford Research Institute *Study of Second Home and Recreation Property Market in the California Desert,* released as part of the California Desert Study in May, 1978, concluded that there is an "existing supply of hundreds of thousands of vacant lots that may never be used." BLM, by establishing a long range program to readjust tenure patterns, has the best opportunity of exerting effective leadership on this issue.

CHAPTER B□IV

PROJECT PLANNING AND REVIEW


public ANNOUNCEMENT of available lands
joint efforts with STATE AGENCIES
joint efforts with LOCAL AGENCIES
establish REVIEW & ADVISORY committee

California law demands that the division of land for sale, lease or finance be considered as a subdivision. All subdivisions must be approved by local government and must conform to the General Plan adopted by that local government. Therefore, all development proposals in the California Desert must be subject to the scrutiny of the local planning body for the area concerned. This is consistent with the fact that development may exert demands upon local service systems, and local governmental agencies may be forced to assume management responsibilities in dealing with present as well as future residents of the area and their impact upon the land.

Any decisions made by BLM must recognize the interests of local government and must fit within the context of local government policies. This, of course, is the rationale behind the FLPMA requirement that local government and the public be given "adequate notice and opportunity to comment upon and participate in the formulation of plans and programs" (FLPMA Sec. 202 f).

Local government policy regarding physical development is established in the local General Plan, which is mandated by State law. All proposals must fit within the policies of the plan, and while it is possible to propose a plan revision on the basis of new information or changing conditions, no project can proceed very far without considering the local government General Plan. In the case of Federal lands previously excluded from consideration by such plans all private proposals will be required to go through the process of review by the local government.

Authority for general plans in California is established in Section 65302 of the Government Code. That section specifies that each general plan shall include at least the following mandatory elements:

Required elements of the General Plan.

(a) A *land use element* which proposes the general distribution and general location and extent of the uses of the land for housing, business, industry, open space, including agriculture, natural resources, recreation, and enjoyment of scenic beauty, education, public buildings and grounds, solid and liquid waste disposal facilities, and other categories of public and private uses of land.

(b) A *circulation element* consisting of the general location and extent of existing and proposed major thoroughfares, transportation routes, terminals and other public utilities and facilities, all correlated with the land use element of the plan.

(c) A *housing element* consisting of standard plans for the improvement of housing and for provision of adequate sites for housing in order to make adequate provision for the housing needs of all economic segments of the community.

(d) A *conservation element* for the conservation, development, and utilization of natural resources including water and its hydraulic force, forests, soils, rivers and other waters, harbors, fisheries, wild life, minerals, and other natural resources.

(e) A *open space element* for the preservation of natural resources including areas for the preservation of plant and animal life; areas for ecologic and other scientific study purposes; areas for the managed production of resources including forestlands rangeland; and areas required for recharge of ground water basins; areas for outdoor recreation, including areas of outstanding scenic, historical and cultural value; areas particularly suited for park and recreation purposes; and open space areas for public health and safety including those which require special consideration because of special conditions such as earthquake fault zones, unstable soil areas, flood plains, watersheds, high risk fire areas and areas required for the protection of water and air quality.

(f) A *seismic safety element* consisting of an identification and appraisal of seismic hazards.

(g) A *noise element* which quantifies the community noise environment.

(h) A *scenic highway element* for the development, establishment and protection of scenic highways.

(i) A *safety element* for the protection of the community from fires and geological hazards.

All the above elements are required. A general plan may, at the option of the local government, also include elements such as recreation, community design and historic preservation.

In addition, local government is authorized to prepare specific plans for an area. A specific plan need not apply to an entire area covered by the General Plan, but must be related to the General Plan and its elements. Usually, the specific plan is considered for a portion of the General Plan area such as, in our case, a Program Area. It will be prepared as an implementation device to provide for an orderly development process when the General Plan does not offer sufficient detail on how an area should be developed. It should be utilized early in the development process to be effective.

In recent years, state government has increased the number of required general plan elements and has in some instances developed guidelines which set standards for compliance with the enabling legislation. But principal responsibility for land use planning continues to rest with local government.

Role of the State

This does not rule out an important role for the State: its impact is primarily through its substantial capital investment in such infrastructure as highways and water importation facilities. That alone is sufficient to demand that State officials be included in all coordination activities. However, the State is additionally involved through its efforts to achieve intergovernmental cooperation, to regulate air and water quality, to stimulate economic development activity, and to enforce State laws as they apply to desert planning and development.

Turning to an examination of the other local agencies which may be involved in the development process we find a large number of jurisdictions. Some of these may be closely related to general purpose government, and some may be special purpose districts totally independent of the city or county in which they operate. For instance, law enforcement may be provided by the county sheriff's department directly under the control of the county board of supervisors, while fire protection may be the responsibility of a locally controlled fire protection district or even a volunteer fire department. Examples of important agencies which are independent of local general purpose government include school districts and water districts or agencies. School districts may be important; new schools are a major public cost of development often ignored in the past. Schools also have an important permanent institutional role, so they should be included in any coordination efforts.

Water agencies are of tremendous importance because of their critical role in shaping the resource budget for a given area. A decision to import water into a basin will greatly increase development pressures, while the lack of sufficient water is a major factor in determining the limits for growth potential. Decisions made to proceed on an importation project must be coordinated with land use planning efforts. Any planning proposal which fails to recognize the impact of importation or non-importation cannot realistically be expected to be successful.

COORDINATION

This brings us once again to the problem of how to coordinate the activities of the various agencies involved in the development process. The General Plan serves as an important instrument to begin the exchange of information necessary for such coordination. However, a continuing effort will be required to monitor the forces which will impact, and be impacted by development.

This points to the need for the BLM to assume a leadership role in assuring that all parties are given early warning of development proposals so that they may make their needs known and can provide insight into how development will affect the demand for public services. Such a process would work best if it could involve representatives from a variety of agencies which could pass information back and forth and discuss proposals in the early stages of the site selection and design process. Since all proposals would be required to comply with both State and Federal environmental analysis requirements, for example, considerable streamlining could be achieved by combining the two statements and their review processes. Unnecessary delays might be avoided, and development processing costs lowered.

The basic sequence of events for a project in obtaining public agency approval would be something like this:

1. Amend the local General Plan as a basis for a preliminary proposal. This would provide a forum for early review of environmental impact.

2. Prepare programs in compliance with the General Plan to carry out conveyance and acquisition.

3. Develop a specific plan, as necessary, to achieve an orderly development process.

All of these actions must be carried out in concert with the appropriate federal and local agencies concerned with development. The list of important agencies might vary from one area to another, but a potential listing of local agencies might include the following:

City and county planning agencies
School districts
Water agencies
Soil conservation districts
Fire protection districts
Law enforcement agencies
Sanitation districts
Flood control agencies

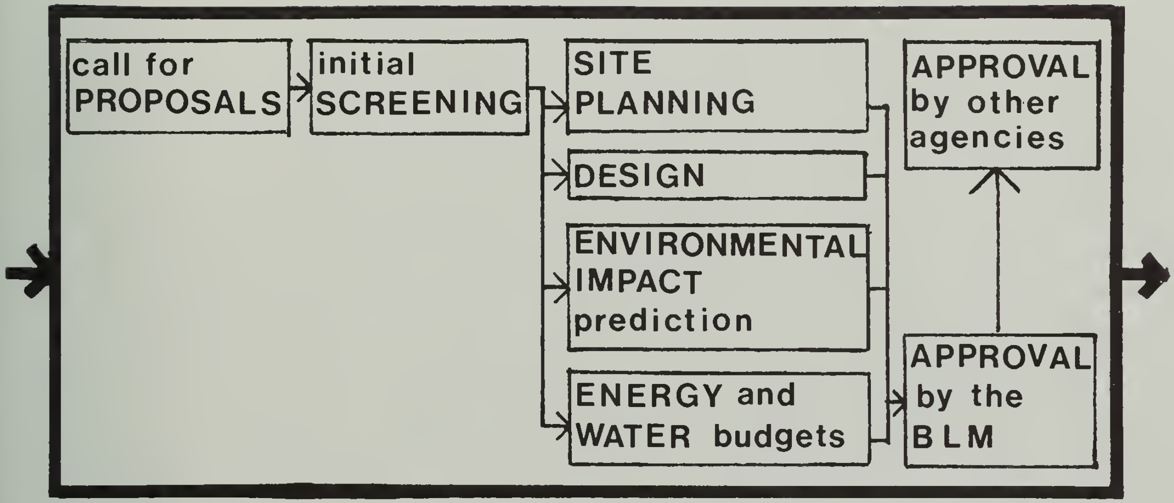
Close liaison with the local planning authorities is necessary to assure that local variations in the structure of institutions be respected. Comparable listings of Federal and State agencies should be generated as appropriate. The importance of public agencies both as land holders and service system developers should be observed.

While in most cases contact with local government will be limited to county agencies, the existence of local jurisdictions is important. Even if an urban settlement is not incorporated as a city there will be a variety of local service agencies to meet local needs. Of particular importance in California is the existence of Municipal Advisory Councils (MAC) which can be created by county govenment to permit development of a locally responsive organization in unincorporated areas. As the name implies, the MAC is advisory in nature with no authority to make or implement policy. It may be created as the first stage in the process leading to incorporation or it may be appointed as an alternative to incorporation. In either case, it provides an important forum for presenting ideas to the local residents and providing a feedback mechanism for obtaining their input.

In summary, the coordination process will vary from place to place, but in any case it will be important and necessary, and it must be structured to fit the needs of all those interests affected by the development.

CHAPTER B·V

SITE PLANNING AND DESIGN



Desert lands meeting suitability criteria for intensive human use will be only a small percentage of the desert as a whole. And even within the few areas that are deemed suitable, desert conditions place severe limitations on the size of human settlements, and make strong demands on their form, function, and siting. In exercising its management responsibilities in the California Desert, it is important that the BLM along with state and local agencies that are involved, recognize these limitations and demands. In the case of lands to be made available for private tenure, it is BLM's responsibility to make sure that private planning and design efforts also take them into account. The terms "multiple use," "sustained yield," and "environmental

"It is the purpose of this section to provide for the immediate and future protection and administration of the public lands in the California desert within the framework of a program of multiple use and sustained yield, and the maintenance of environmental quality." (FLPMA; Section 601)

quality," which appear so frequently and forcefully in FLPMA are as applicable to the landscape of human use and settlement as they are to the natural landscape. The congressional demand ". . . to create and maintain conditions under which man and nature can exist in productive harmony" provides a strong direction for site planning and design.

Combining the legacy of knowledge gained from the successful desert dwellers of the past with what we know from contemporary research and analysis, we can develop a useful collection of applicable principles and techniques for adaptation of human settlements to desert conditions. This chapter presents a summary of such principles and techniques as a guide for their use in the California Desert Conservation Area. Part C, which follows, gives detailed descriptions and analyses.

Most critical resources

In the desert, as in most other places, the most critical resources are energy and water. A major problem with energy is that for a large portion of the time there is too much of it, in the form of uncontrolled solar radiation at temperatures that are difficult to utilize, and stressful—even dangerous—for humans. So in dealing with energy under desert conditions, we are usually concerned with lowering temperatures to the comfort zone in areas inhabited by humans, and with concentrating and storing energy in ways that can make it useful when and where it is needed.

Water, on the other hand, is always in short supply. Desert water management is usually concerned with guiding and collecting water from a large area and concentrating it for use in a small area; with conservation and recycling; with budgeting the use of water so as to make every drop do as much for us as possible; and with sustaining the supply.

DESIGN FOR ENERGY CONTROL

The design for human habitats sustainable under desert conditions requires tight clustering, proper solar orientation, compatible planting, careful use of materials, and direct use of solar energy. Where all of these are accomplished, microclimates within inhabited areas can be efficiently maintained within the human comfort zone.

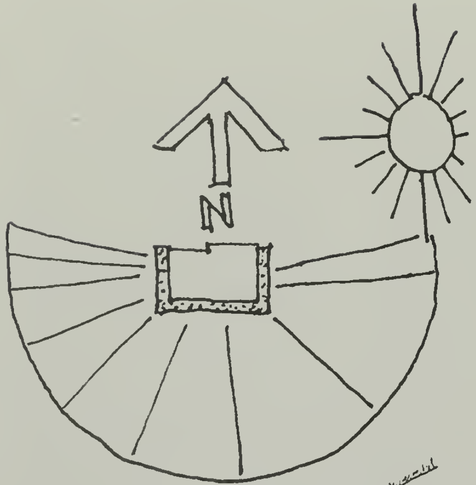
Clustering

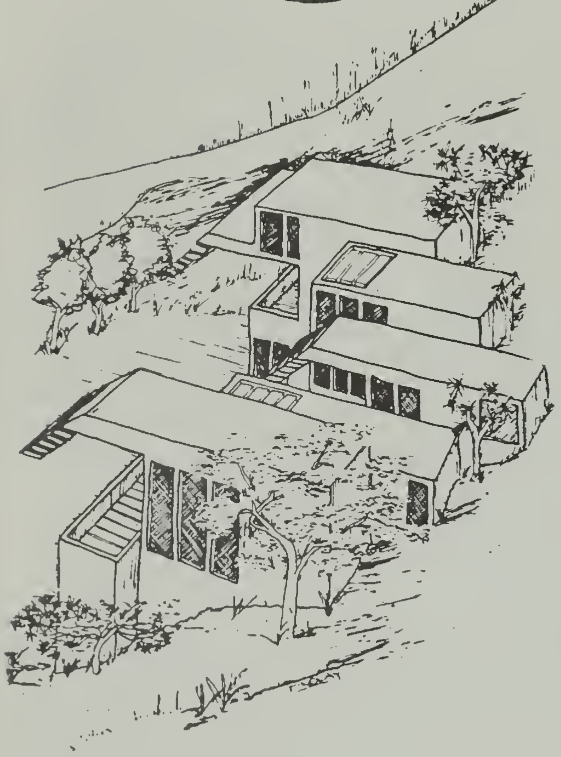
Virtually all historical examples of successful desert settlements feature tightly clustered arrangements of buildings. This is so for several reasons.

Tightly clustered buildings provide shade for the pedestrian spaces between then and, to some degree, for each other, thus creating a microclimate that is cooler overall than the open areas surrounding it. Clustered building with shared walls expose smaller outside surfaces to the desert heat, and thus minimize their heat gain during the day. Humans are required to spend less time in moving from one building to another, and what time they do spend can be mostly in the shade cast by structures. And at the same time, the smaller area of land covered means less alteration of desert ecosystems. As mentioned in the preceeding chapter, those desert plant communities that offer the most inviting conditions for human habitation are generally the ones that should be disturbed as little possible.

Solar Orientation

As also previously mentioned, North orientations are coolest because they receive no direct sun, and South





orientations offer the greatest flexibility because they offer direct solar radiation which can be utilized when it is needed or partially or completely blocked out by architectural devices or by vegetation. It follows that under desert conditions, site planning should provide for maximum north and south exposures and minimal east and west exposures. The architectural devices that can be applied to make maximum use of the desirable exposures in controlling microclimate are almost unlimited.

Planting

The natural desert landscape features relatively few native plants that are useful in providing for the needs of human settlements. This means that most plant materials introduced with human settlement must be exotics which require considerable attention and consume valuable resources. Used with care and forethought, however, limited plantings can more than justify the cost of their maintenance with their contribution to the liveability of the desert environment.

In clustered arrangements, trees can work with buildings to provide shade. In more extreme desert climates, such as higher elevation areas of the Desert Slope, deciduous trees can be used to shade the south walls of buildings during the summer while admitting solar radiation during the winter. Besides the shading effects, plants act to cool the atmosphere by creating a zone of cooler still air and by the release of water vapor into the air.

Use of Materials

Temperature extremes are characteristic of desert climates: hot days and cold nights, hot summers and cold winters. For this reason, building materials that absorb heat slowly and emit it slowly are most appropriate to desert conditions. In general this means heavy, massive materials like stone, brick, concrete and adobe. These materials help to establish more constant temperatures within manmade environments, mitigating the extremes by the "flywheel effect." Lighter materials, by contrast, fluctuate with the local climate. For this reason, and because the component materials deteriorate quickly under desert conditions, conventional wood frame building techniques are not suitable for desert use.

An extension of this principle is the use of structures that are partly or wholly undergound. Desert biological communities feature a great many animals that adapt to the extreme conditions by burrowing, or living underground, where the mass of the earth itself provides the flywheel effect. Human communities can do the same by sinking their structures into the ground. The potential benefits are great, though the initial cost is high.

Direct Use of Solar Energy

Collection and storage of the very intensive solar radiation of the desert is a practical possibility for a variety of applications. Solar collectors can provide for heating and cooling, though if buildings are properly designed, this will not be needed in most places. Solar cells and small scale solar generating plants can provide electrical power on a local basis. With presently available technology the cost is high, but indications are that with greater volumes of use the cost will descend rapidly. Even at present day costs, with careful use and conservation measures, the use of these devices is economically feasible.

In many areas of the desert, wind levels are high enough to make windmills an economic source of power. For applications that do not require power at particular or pre-established times, such as water pumping, windmills are especially practical and cheap.

DESIGN FOR WATER CONSERVATION

The physical form of any sustainable desert settlement will incorporate an effective system of water flow. The essential elements of such a system include a clearly defined role in the regional water flow system, a means a collection, a means of storage, an allocation program, and a means of recycling.

Role in the Regional Water Flow

Any human water-using activity is certain to assume an important role in the larger system of water flow into which it is inserted. If it is not carefully arranged, this role can be extremely destructive. This is particularly true where human activity diverts water needed by other creatures downstream. On the other hand, it can be possible for limited human settlements to take the water they need without detrimental effects, and even, in some cases, with beneficial effects. The Desert Slope example includes a detailed analysis of the regional water flow. In this case, the fact that only 3.8 percent of the water falling as rain in the foothills eventually reaches underground storage, the rest being lost to evaporation, is of critical importance in relating the settlement pattern to the regional water flow. A community located at the right point in the downhill line of flow can take out and use some of this water that would otherwise be evaporated away without a net loss to the larger flow. Furthermore, if this water is recycled and eventually returned to the system, possibly by being percolated into the ground, the human use could result in a net gain to the natural system downstream.

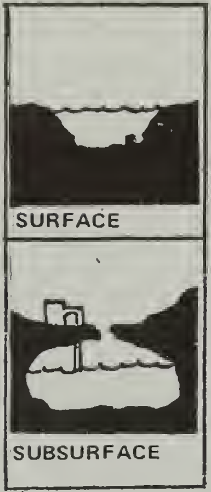
Such opportunities for beneficial symbiosis will not exist in every case. But by analyzing and describing the larger system, using the techniques shown in the Desert Slope example, potentials can be identified and the effects of the smaller unit on the larger whole can be determined.

Water Collection

Stable, permanent human uses of the desert nearly always depend on water supply from a far larger landscape than that which is directly occupied by the activity. Planning of the watershed and its management will be an essential part of planning for the activity itself.

The size of the watershed will vary according to the volume of rainfall, the soil and vegetation types and the uses for which water is needed. In Israel, extensive research has been carried out on the ancient Nabatean water harvesting technique. The Nabateans carried on a high volume of agricultural production by guiding the runoff from a large catchment area onto small, intensively managed fields. The ratio of water catchment area to land actually in production was about 30 to 1. Such techniques will be very useful in the California Desert, for small scale agriculture as well as for providing domestic water supplies. But in order to use them effectively, the catchment area and the path of flow into the use area should be defined in the early stages of planning. In practice, they will function as an interacting and inseparable unit.

Storage



See Part C

Desert rainfall is infrequent, sporadic, and unpredictable. Rainless periods may last up to two or three years. Therefore, it is necessary to have some means of long term storage. Due to high evaporation rates in the desert, this is best located underground. Where large aquifers and high water tables exist, water may be simply allowed to percolate into the ground and drawn up when it is needed.

Where such conditions do not exist, or where the need is primarily for shorter term storage, there are numerous small storage devices. At least one ancient civilization in the Negev Desert provided cisterns under its buildings. Runoff was diverted into these, and the storage capacity seems to have been adequate to sustain the population between rainfalls.

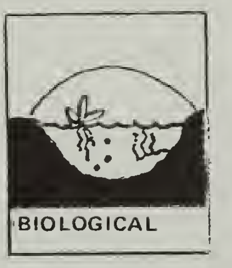
Allocation Program

It is obvious that under desert conditions, where there is no surplus water available to be wasted, all of the appropriate water conservation measures should be applied. In most cases a system of allocation to various uses will be needed, and should be a part of the initial planning. In allocating water, quality should be matched to use. Only a small portion of the total quantity of water used need be of potable quality. “Gray water” can be used for toilet flushing, and treated sewage effluent can be used for landscape irrigation. By matching quality to use, a system can be developed for using water several times, and then restoring it to high quality for futher reuse. While there will be some loss in each cycle, the program can be fine-tuned to a level of per capita consumption far below that of the average city.

Recycling

It is unlikely that any human community can sustain itself on a long term basis with an acceptable contemporary standard of living in the desert without an effective means of recycling its water. In general, conventional sewage treatment methods are too expensive, too large in scale, and too energy intensive for use in small desert communities. Small scale biological treatment systems offer a workable alternative. Such systems involve a series of steps that begins with screening and a settling tank in which solids are separated out. From there, the water goes through a series of tanks in which aquatic plants like water hyacinths and bull rushes take up the nutrients. In the later tanks, fish may be grown along with the aquatic plants, thus providing high quality protein as a byproduct. After several days of treatment in a series of tanks, the water can be brought up to potable standards. The process can be intensified, and evaporation losses minimized by a greenhouse enclosure. It can also be used as the basis for a diverse mixed food production system in which nutrient laden water is used to irrigate fruit and vegetable crops.

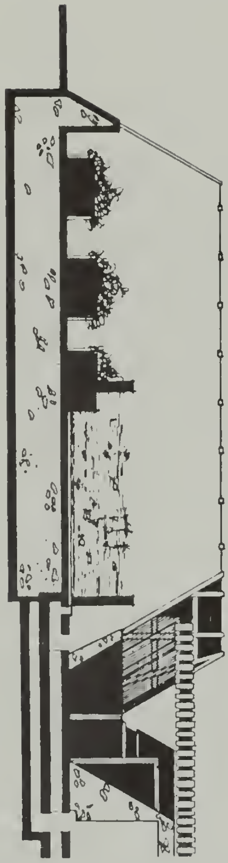
Such treatment systems are particularly appropriate for use in the desert because of their efficiency, low cost, small scale, and productivity, all of which are important for communities that are not rich in resources but which are forced by the limitations of their environment to be self-reliant.



See Part C

FOOD PRODUCTION

In many desert communities, it will increasingly in the future be desirable to incorporate intensive local agricultural activity, either to provide some portion of



community food supplies, or as an income-producing activity. However, this may be difficult to sustain over any significant period of time using conventional agricultural technologies. Few desert soils are fertile enough to support large monocultural field crops, and water supplies are generally inadequate. Large imports of energy and nutrients would be needed for traditional methods, and these, again, would be inconsistent with stated desert policies. So alternative approaches should be considered.

A number of new as well as revived ancient methods are under development in various parts of the world. They generally are small in scale, are adaptable to the needs of small groups of people with limited means, and make the most of the resources available. The ancient Nabatean catchment system mentioned just above is an example that may find very direct future application in the California desert, for example in the Desert Slope area. Among more recent innovations, the sewage recycling system just mentioned could be important. It recovers not only water, but also nutrients, which may be further processed through use of water plants and fish for animal fodder in producing eggs or milk, for example.

Greenhouses

The most effective means of intensifying food production and conserving water in the desert is by the use of greenhouses. Capital cost of greenhouses is high, but precious humidity can be retained, and conditions for crop production can be maintained at near optimum levels. In these highly controlled conditions, the natural productivity of local soils is not so important; fertility can be more esily developed and controlled artificially. Water consumption can be kept to a minimum because evaporated water can be condensed and reused.

While greenhouses are unquestionably expensive to build and to operate, studies have shown the total cost of vegetables produced in this way to be often less than that of conventionally produced vegetables if transportation and distribution costs are taken into account.

See: Evanari, M., L. Shanan and N. H. Tadmor, "Runoff Agriculture in the Negev Desert of Israel." In: ***Food, Fiber and the Arid Lands.*** *William G. McGuinnes, Bram J. Goldman, and Patricia Paylor, eds., University of Arizona.*

Intensive Gardening

Over the past few decades, a number of techniques have been developed for producing significant volumes of food even on small areas of land. In general, these rely heavily upon human effort, but require far less imported energy than traditional food production and distribution methods. Through utilization of compost, earthworms, animal manure and other natural materials, quality of the soil can be improved. Successful, stable farming of such crops in the desert may involve complex combinations of crops occupying the same land area, sometimes on several levels, and using water sparingly.

Intensive gardening techniques can be utilized to great advantage under desert conditions because they provide ways of extending the limits imposed by poor soils and lack of water without risking ecological impacts and long term problems of declining productivity. But they do require a great deal of work, and therefore will probably be used only by the most committed of long term desert settlers.

See Part C

Native Crops

Unfortunately, relatively few plants native to the California desert produce foods edible by humans. Among the few are pinyon pines (nuts), beaver tail cactus (extensively eaten, and considered a delicacy in Mexico), yucca (eaten in Cuba), cat's claw (seeds ground into flour), and mesquite (tea and flour). While obivously not capable of providing a balanced (or very appealing) diet, these plants are easily grown without irrigation or fertilization and can provide for at least some basic needs.

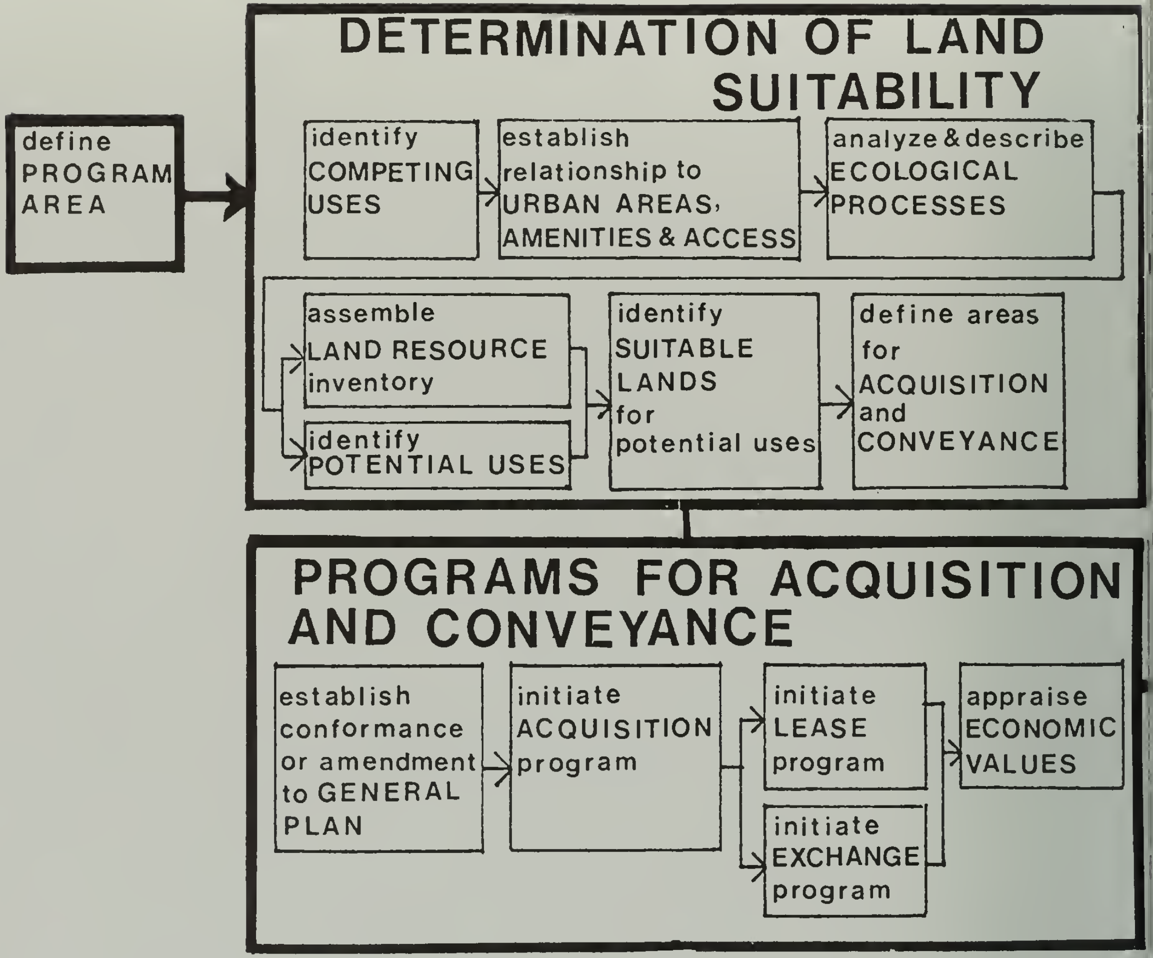
Other desert plants can serve some nonfood needs. These include Joshua trees (fiber) and Mojave yucca (soap), jojoba (lubricants) and guayule (rubber). The last two, if planted in large quantities, can produce exportable cash crops, which might even become a major economic base for a desert community.

PLANNING WITH DESERT RESOURCES

It is important that any plans for desert settlements demonstrate that they can provide a sustainable environment with respect to energy, water and food, whether locally produced or imported. This will require a careful accounting in advance. Resource budgets should be developed for every proposed design, showing how energy and water will be utilized by the community, what the quantities of any inputs and outputs are to be expected and what the sources and sinks for these will be. These budgets will be displayed in the projected costs — dollars, kilowatt hours, gallons of gasoline — to the community, and the benefits yielded the desert resident.

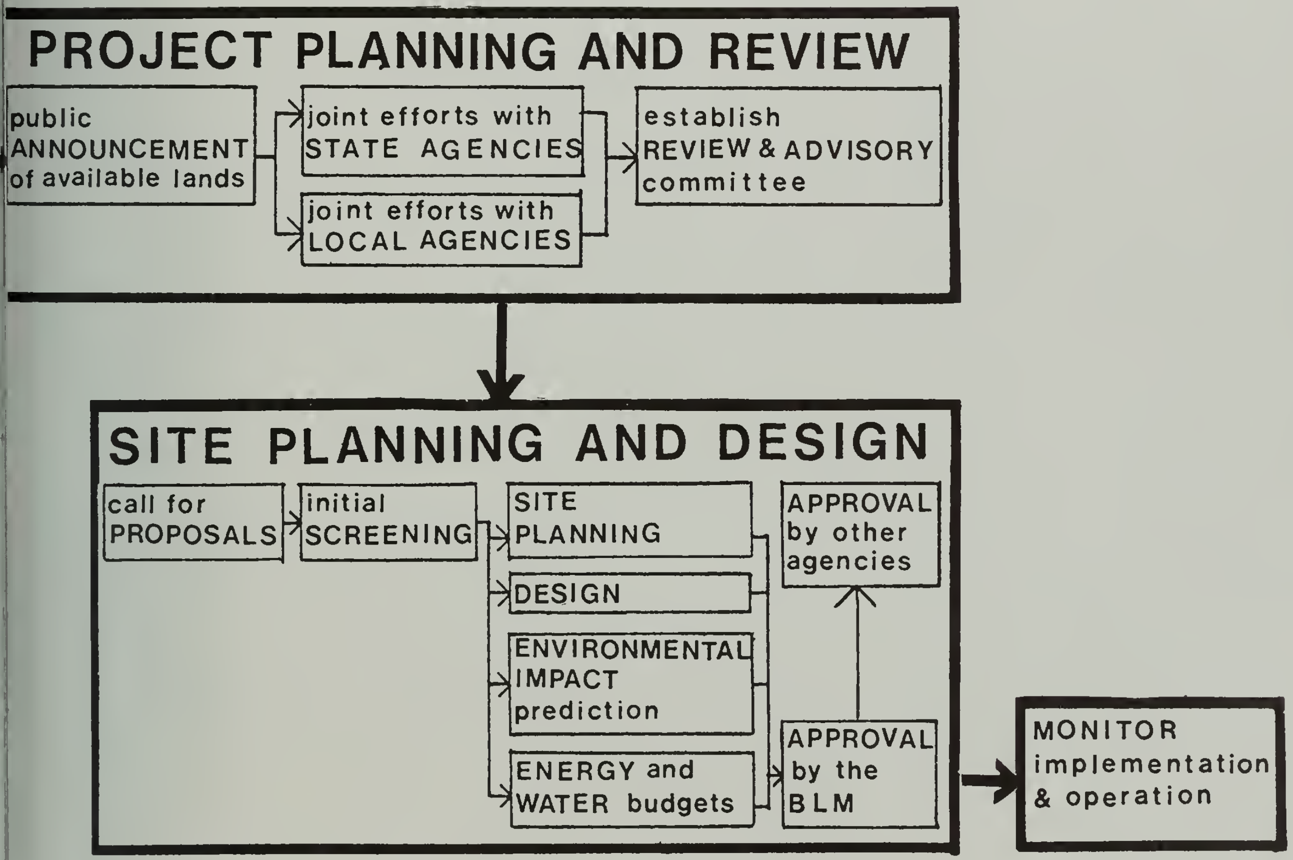
The tightly grouped arrangement of plants and buildings suggested here for the typical energy- and water-conserving — conserving desert community will be quite different in character and ecological function from the usual, existing California desert communities. Instead, these future communities will be like oases — cooler, damper, greener, more active and productive, but still fitting appropriately into the larger environment of the desert landscape, and having a minimal inpact upon it. These objectives of human use are in tune with the objectives of FLPMA to provide multiple use and sustained yield of benefits. And they satisfy the requirement of minimum impact on the natural values of the desert.

For a complete discussion of the subject and a listing of numerous desert-related technologies, see Erika Aschmann: ***Handbook of Desert Development.*** *MLA thesis. California State Polytechnic University, Pomona.*


DETERMINATION OF LAND SUITABILITY
define PROGRAM AREA
identify COMPETING USES
establish relationship to URBAN AREAS, AMENITIES & ACCESS
analyze & describe ECOLOGICAL PROCESSES
assemble LAND RESOURCE inventory
identify POTENTIAL USES
identify SUITABLE LANDS for potential uses
define areas for ACQUISITION and CONVEYANCE
PROGRAMS FOR ACQUISITION AND CONVEYANCE
establish conformance or amendment to GENERAL PLAN
initiate ACQUISITION program
initiate LEASE program
initiate EXCHANGE program
appraise ECONOMIC VALUES

CHAPTER B·VI

PROCESS SUMMARY


PROJECT PLANNING AND REVIEW
public ANNOUNCEMENT of available lands
joint efforts with STATE AGENCIES
joint efforts with LOCAL AGENCIES
establish REVIEW & ADVISORY committee
SITE PLANNING AND DESIGN
call for PROPOSALS
initial SCREENING
SITE PLANNING
DESIGN
ENVIRONMENTAL IMPACT prediction
ENERGY and WATER budgets
APPROVAL by other agencies
APPROVAL by the BLM
MONITOR implementation & operation

CHECK LIST FOR THE LAND TENURE ADJUSTMENT PROCESS

I. DEFINE BOUNDARIES OF PROGRAM AREA.

A. Areas of mixed ownership.
B. Other reasons for acquisition or conveyance.
C. Physiographic boundaries.
D. Political boundaries.

II. DETERMINE LAND SUITABILITY.

A. Areas of historical and cultural value.
B. Areas of resource value.
C. Areas of unique natural character.
D. Unusual hazards.
E. Relation to urban areas.
F. Potential uses.
G. Ecological factors.
    1. Hydrology
    2. Soils
    3. Plant communities
H. Land resource inventory.
I. Definition of suitability.
J. Designation of areas for acquisition and conveyance.

III. PROGRAMS FOR ACQUISITION AND CONVEYANCE.

A. Amend county General Plan.
B. Establish acquisition program.
C. Establish lease program.
D. Establish exchange program.
E. Appraise economic values.

IV. PROJECT PLANNING AND REVIEW.

A. Public announcement of available lands.
B. Liaison with related state agencies.
C. Liaison with related local agencies.
D. Establish review and advisory committees.

V. SITE PLANNING AND DESIGN.

A. Call for proposals.
B. Initial screening for compatibility.
C. Develop and review of:
    1. Site planning.
    2. Design.
    3. Environmental impact prediction.
    4. Energy budget.
    5. Water budget.
D. Approval by BLM.
E. Approval by other agencies.

VI. MANAGEMENT AND MONITORING OF LEASES.

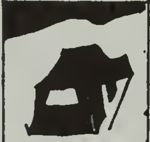
A. Oversee implementation.
B. Observe and record changes in environment.
C. Establish and maintain data base for desert use and development.

PART C
ENVIRONMENTAL GUIDELINES

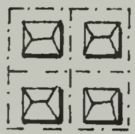
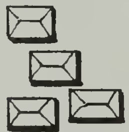
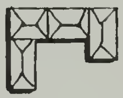
The charts on the following pages are intended to serve as a general guide, first in determining whether or not a particular activity is suitable for a given landscape, and then, if it is deemed suitable, in determining the appropriate location, type and form of that activity. The list of activities includes most of those normally encountered in the California Desert, though it does not pretend to be comprehensive.

For each activity, the natural processes likely to be impacted are listed; impacts are rated as to whether they are considered positive (desirable) or negative (undesirable), and as to degree. Adaptability to desert conditions is also estimated as high, medium or low. In the last column, criteria for location are given.

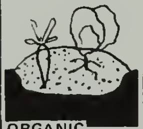
The format is also intended to provide a basis for preparation of environmental impact reports and statements for trades and leases involving developments that include these activities.

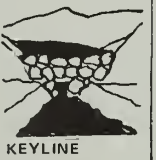
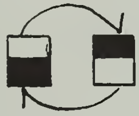
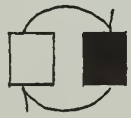
ACTION	COMPONENT			DESCRIPTION	PROCESSES IMPACTED	IMPACT POS.	IMPACT NEG.	ADAPTABLE TO DESERT	LOCATIONAL CRITERIA
RECREATION	PASSIVE	HIKING-CAMPING	PRIMITIVE	Minimum site modification. Rustic or rudimentary improvements designed for protection of the site rather than comfort of the users. Use of synthetic materials avoided. Spacing informal and extended to minimize contact with others. Minimum controls are subtle with no obvious regimentation. No motorized access provided or permitted. Maximum opportunity for experiencing solitude.	soil mantle		○	HIGH	Primitive environment is dominant. Isolated location with visual amenities and unique experiences. No access to motorized vehicles
					soil compaction		○		
					soil erosion		○		
					surface dust		○		
					vegetation:		○		
					root disturbance		○		
					wildlife		○		
			SECONDARY PRIMITIVE	Little site modification. Rustic or rudimentary improvements designed for protection of the site rather than comfort of the users. Avoids use of synthetic materials. Spacing informal and extended to minimize contact with others. Minimum controls are subtle with little obvious regimentation. Motorized access provided or permitted over primitive roads. Opportunity for solitude.	soil mantle		○	HIGH	Near primitive environment. Topography should allow limited access. Level areas for overnight camping and rudimentary improvements.
					soil compaction		○		
					soil erosion		○		
					surface dust		○		
					vegetation:		○		
					root disturbance		○		
					wildlife		○		
			 INTERMEDIATE	Moderate site modification. Facilities for protection of site and comfort of users. Native materials usually influence contemporary/rustic design of improvements. Provides inconspicuous vehicular traffic controls. Roads may be hard surfaced and trails formalized. Primary access to site may be over well traveled standard roads. Development density about 3 family units per acre. Informal visitor information.	groundwater		○	HIGH	Environment is essentially natural. Topography should allow greater motorized access. Site conditions (i.e. soils, slope %, vegetation) must allow for more intensive use without detrimental environmental impacts. Site modifications should avoid impact to visual quality.
					water quantity		○		
					runoff		○		
					soil mantle		○		
					soil compaction		○		
					soil erosion		◐		
					root disturbance		○		
					wildlife		○		
					imported resources:		○		
					energy materials		○		
					visual quality		○		
			SECONDARY MODERN	Heavy site modification. Some facilities specifically for comfort and convenience of users, and designs may incorporate synthetic materials. Extensive artificial surfacing of roads and trails. Vehicular traffic controls present and obvious. Primary access over paved roads. Development density 3 to 5 family units per acre. Plant materials usually native. Visitor information services usually provided. Blends opportunities for some degree of solitude, security, and socializing.	groundwater		○	HIGH	Environment is pleasing and attractive, but not necessarily natural. Reasonable motorized accessibility. Avoid impacting areas of high watershed, vegetation, or wildlife value.
					water quantity		○		
					runoff		◐		
					soil mantle		◐		
					soil compaction		◐		
					soil erosion		○		
					streambed		○		
					root disturbance		◐		
					wildlife		○		
					imported resources		○		
					visual quality		◐		
			MODERN	High degree of site modification. Facilities designed for comfort and convenience of users include flush toilets; may include showers, laundry facilities, electrical hookups, synthetic materials. Obvious regimentation with formal sites, walks, surfaced roads and trails. Access usually by high speed highways. Development density 5 or more family units per acre. Plant materials native or foreign to environment. Formal visitor information services usually available.	groundwater		○	HIGH	Pleasing environment to the novice camper. Site modifications should avoid impacts to watershed, vegetation and wildlife. Easy access by motorized vehicle.
					water quantity		◐		
					runoff		◐		
					soil mantle		◐		
					soil compaction		◐		
					soil erosion		◐		
					streambed		○		
					root disturbance		◐		
					wildlife		◐		
					imported resources		◐		
					visual quality		◐		
	ACTIVE		OFF-ROAD VEHICLE	Off road vehicles (O.R.V.) are specially designed, modified motorcycles and four-wheeled vehicles (jeeps, trucks, dune buggies, etc.) for use on rough terrain. O.R.V. recreational uses must be restricted because of irrepairable damage to the fragile desert environment. Uses must be confined to a limited land area and possibly to a fixed trail system. Noise, emissions, spark, speed and density must be controlled; licenses, permits and laws enforced.	water quantity		○	LOW	Avoid. areas of high watershed value, sensitive vegetation or wildlife habitat; areas of highly erodable soils; impacting areas of high scenic qualities; areas of significant historical, archaeological, cultural or scientific value; areas of passive recreation or settlement use.
					runoff		○		
					soil mantle		●		
					soil compaction		●		
					soil erosion		●		
					root disturbance		●		
					wildlife		●		
					imported resources		○		
					visual quality		●		
					air quality		○		

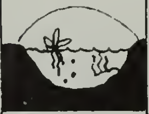
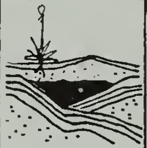
LOCATIONAL CRITERIA	ADAPTABLE TO DESERT	IMPACT NEG.	IMPACT POS.	PROCESSES IMPACTED	DESCRIPTION			COMPONENT	ACTION
Support facilities required in addition to imported materials and energy Large expanses of open, flat terrain. Proximity to existing roads. Avoid impacts to visual quality and long views; areas of aquifer recharge, sensitive vegetation, wildlife habitat.	LOW	◐ ◐ ● ● ● ● ● ● ◐ ●		runoff drainage patterns soil mantle soil compaction aquifer recharge root disturbance air quality noise imported resources visual quality	Recreational powered aircraft permitted in public airspace but restricted flight paths over military facilities and near airports/landing strips. Most major impacts occur because of the need for support facilities (airports) and services (fuel, repair). Noise and emission standards should be set and enforced to avoid adverse impacts near settled areas (by Federal Aviation Administration).	POWERED	FLIGHT	ACTIVE	RECREATION (CONT.)
Proximity to existing roads. May require sufficient altitudes and air currents to keep aparatus aloft.	HIGH	◐ ○ ◐ ○ ○		soil mantle soil compaction root disturbance wildlife visual quality	Recreational, powerless aircraft, such as sailplanes, balloons, and hang gliders may be permitted with restrictions on locations, and flight paths. Aircraft operations are restricted and controlled by the federal aviation administration. Sailplane and balloon launching usually requires road access and some power source, such as power winch or power tow plane.	NON-POWERED			
Hunting in designated areas of sufficient fauna to warrant population control. Shooting in designated areas so as not to threaten health and safety of people.	HIGH	○ ○ ● ◐		soil mantle root disturbance wildlife noise	Recreational use of firearms, bows and arrows, and traps for hunting and killing of animals. Shooting for sport may be permitted with restrictions on locations and areas.	HUNTING/ SHOOTING			
Limited developed area to minimize environmental impacts. Avoid areas of high watershed value, sensitive vegetation or wildlife habitat, highly erodable soils. Soil suitability for intensive use and development. Good accessibility from existing roads Site should contain visual and cultural amenities.	MOD.	◐ ◐ ● ◐ ◐ ● ◐ ◐ ○ ○		runoff drainage patterns soil mantle soil compaction soil erosion root disturbance wildlife visual quality air quality noise	A destination place with an image attraction that provides visitors/vacationers with unique recreational opportunities and accommodating facilities. For example, hot springs, health resort, fat-farm, dude ranch.	DEVELOPED RESORT/ CAMPGROUND			
Areas of unique scenic, historic, cultural and scientific value. Avoid impairment of visual corridors. Convenient accessibility by motorized vehicle.	HIGH	◐ ● ◐ ○ ○ ○ ◐ ○		runoff soil compaction soil erosion surface dust sedimentation wildlife visual quality noise	Driving on established paved roads and/or highways for sightseeing recreational purpose. Establish a scenic route that provides unique and varied visual experiences with ample turn-outs and way stations (rest areas). Visitor interpretive information and environmental education might be included at turn-outs in the form of graphic plaques as well as short nature trails in unique areas.	SIGHTSEEING-AUTO		PASSIVE	
Areas of significant ecological, vegetation, wildlife, watershed and resource values. Limited access for scientific observation, hiking, backpacking.	HIGH	○ ○ ○ ○ ○ ○ ○ ○		soil mantle soil compaction soil erosion root disturbance wildlife visual quality air quality noise	Observation of the environment—ecosystems, native flora and fauna—for personal, educational, scientific purposes. Forms of observation may vary from visual (photography, field glasses, telescope) to scientific instrumentation (to record wind velocity, water quantity and quality, seismic activity, etc.). Areas and trails might be established to provide access for observation and special reserve areas with restricted access.	NATURE STUDY			

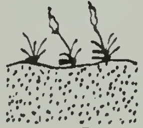
ACTION	COMPONENT			DESCRIPTION	PROCESSES IMPACTED	IMPACT		ADAPTABLE TD DESERT	LOCATIONAL CRITERIA
						PDS.	NEG.		
SETTLEMENT	DENSITY		 SINGLE FAM. LG. LOT	A single family home occupying 2.5 to 5 acres per parcel. Perpetuates scattered settlement status quo with little impact on environment for each individual house. But when effects are compounded, especially establishment of supporting services, negative impacts are felt. Inefficient distribution pattern for goods and services.	groundwater recharge water quality water quantity runoff soil solar radiation, reflection vegetation wildlife imported resources air quality visual quality noise		○ ○ ○ ○ ◑ ○ ○ ○ ● ○ ● ○	MOD.	Proximity to adequate water supply with provisions for recycling of water and waste. Proximity to existing infrastructure. Soils suitable for structures. Avoid: soils with high agricultural potential; areas of aquifer recharge, sensitive vegetation or wildlife habitat; areas of high watershed value, transport, storage. Avoid: active seismic areas; areas of high visual quality, long views; slopes in excess of 25%; areas designated for preservation.
			 SINGLE FAM. SM. LOT	A single family home occupying 25 to 2.5 acres per percel perpetuates more concentrated settlement status quo. Impacts increasing along with density of developed parcels, roads, and utility lines Inefficient distribution of goods and services. Future site plans should result from adaptation to site characteristics, suitabilities and sensitivities.	groundwater recharge water quality water quantity runoff soil solar radiation, reflection vegetation wildlife imported resources air quality visual quality noise		◑ ○ ◑ ◑ ◑ ◑ ● ○ ● ○ ● ○	MOD.	Same as single family large lot.
			 DETACHED CLUSTERS	Single family housing units arranged in close proximity to each other. Site plans should result from careful analysis of site suitabilities and sensitivities and can adapt to diverse landscapes. Has the potential of preserving natural processes, more efficient provision of goods and services, and common access.	groundwater recharge water quality water quantity runoff soil solar radiation, reflection vegetation wildlife imported resources air quality visual quality noise		◑ ○ ◑ ◑ ◑ ◑ ◑ ○ ● ○ ◑ ○	MOD.	Same as single family large lot.
			 ATTACHED CLUSTERS	Single or multiple family housing arranged with common walls adjoining units. This is the most efficient arrangement in terms of materials and energy requirements. Consolidation of housing units and people optimizes distribution of goods and services. Site plans should result from careful analysis of site characteristics, sensitivities, and suitabilities, and adapt symbiotically with natural processes in the landscape.	groundwater recharge water quality water quantity runoff soil solar radiation, reflection vegetation wildlife energy and materials air quality visual quality noise		○ ○ ◑ ◑ ◑ ◑ ◑ ○ ◑ ○ ◑ ○	MOD.	Same as single family large lot.
	FORM		 MULTIPLE STORY	Buildings with two or more levels. Visual quality may be negatively impacted if multiple stories disrupt important long views and change the character of long and short views. Such buildings might be designed to alter natural air flow for a planned, desirable purpose, such as microclimate control; and may positively affect the visual character within a cluster of multiple story units.	water quality water quantity runoff soil solar radiation, reflection vegetation wildlife energy and materials air quality visual quality noise		○ ◑ ◑ ◑ ◑ ◑ ○ ◑ ○ ◑ ○	MOD.	Same as single family large lot.
			 SINGLE STORY	Housing form of one floor. Visual impact is minimized due to limited height.	water quality water quantity runoff soil solar radiation, reflection vegetation wildlife energy and materials air quality visual quality noise		○ ○ ○ ◑ ○ ◑ ○ ● ○ ◑ ○	MOD.	Same as single family large lot.

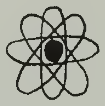
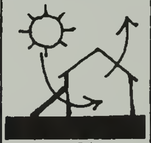
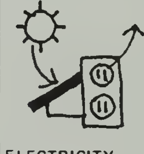
ACTION	COMPONENT			DESCRIPTION	PROCESSES IMPACTED	IMPACT		ADAPTABLE TO DESERT	LOCATIONAL CRITERIA
						POS.	NEG.		
SETTLEMENT (CONT.)	FORM		SEMI-SUBSURFACE	Structure that is partially beneath ground level to take advantage of earth's insulation and to minimize visual impact.	water quality		○	HIGH	Same as single family large lot with addition that soils be capable of excavation.
					water quantity		○		
					runoff		○		
					soil		◐		
					solar radiation, reflection		○		
					vegetation		◐		
					wildlife		○		
					energy and materials		◐		
					air quality		○		
					visual quality		○		
					noise		◐		
			SUBSURFACE	Structure that is completely beneath ground level to take advantage of earth's insulation and to minimize impact.	water quality		○	HIGH	Same criteria as semi-subsurface.
					water quantity		○		
					runoff		○		
					soil		◐		
					solar radiation, reflection		○		
					vegetation		◐		
					wildlife		○		
					imported resources		◐		
					air quality		○		
					visual quality		○		
					noise		○		
AGRICULTURE	CONVENTIONAL		ROW CROPS	Produces food and fiber in areas where yields are extracted at the expense of large tracts of land, costly machinery, water, elaborate irrigation systems, chemical additives (fertilizer, pesticide), and high energy inputs. Monocultural row crop practices are utilized to promote easier maintenance and harvesting. While certain fruit and vegetable crops may favor the climate, limits of water and soils restrict application in desert environment.	water quality		◐	LOW	Soils of high fertility, moderate infiltration, low salinity. Water availability, low in mineral content. Prefer southern exposure, slopes 0-15%. Proximity to agricultural supplies, transportation, settlement. Avoid. areas of high scenic quality, long views; areas of aquifer recharge, sensitive vegetation and wildlife habitat.
					water quantity		●		
					evaporation		●		
					water logging		○		
					soil fertility	●			
					soil erosion		○		
					soil mantle		●		
					soil salinity		○		
					vegetation		●		
					wildlife		○		
					imported resources		●		
					visual quality		●		
			TREE CROPS	Produces food and fiber in areas where yields are extracted at the expense of moderately large tracts of land, costly machinery, water, irrigation systems, chemical additives of fertilizer and pesticides, and high energy inputs. Monocultural row crop practices are utilized to promote easier maintenance and harvesting. While climate may be ideal for certain fruit and nut crops, the limits of water and soil restrict application in the desert.	water quality		◐	LOW	Same criteria as row crops.
					water quantity		●		
					evaporation		●		
					water logging		○		
					soil fertility	●			
					soil erosion		○		
					soil mantle		●		
					soil salinity		○		
					vegetation		●		
					wildlife		○		
					imported resources		●		
					visual quality		●		
			GRAZING	The consumption of native vegetation, water, and land by livestock animals. Certain areas are deemed suitable for grazing, based upon ample forage and rainfall. However, this is at the expense of destroying native vegetation, wildlife distribution, soil compaction, and contamination of water supply, ground water.	water quality		◐	MOD	Areas of sufficient precipitation to support forage. Soils of high fertility, moderate infiltration, low salinity. Degree of slope depends on type of animal grazed and soil capability. Proximity to agricultural supplies, transportation. Avoid: highly erodable soils, areas of high scenic quality, long views; areas of aquifer recharge, sensitive vegetation, and wildlife habitat.
					water quantity		○		
					soil fertility	○			
					soil erosion		●		
					soil mantle		◐		
					soil compaction		◐		
					soil salinity		○		
					vegetation		●		
					wildlife		○		
					imported resources		○		
					visual quality		○		
			NATIVE PLANT	Produces food, fiber, chemicals, materials, and plants for landscaping. Utilizes native or naturalized plant materials as they grow. Adapted to desert climatic conditions. Need little irrigation. Potential food crops include cat's claw (seeds ground into flour), beaver tail cactus (edible pads and fruit), mesquite for tea and flour, pinyon pine for nuts, and salt bush for livestock feed. Joshua trees are a fiber source, Mojave yucca for soap, and other natives supply medicinal products, rubber, and lubricants.	water quantity		○	HIGH	Proximity to waste water treatment. Soils of moderate infiltration, low salinity. Water availability, low mineral content. Proximity to agricultural supplies, transportation. Avoid: areas of aquifer recharge, sensitive vegetation, and wildlife habitat; areas of high scenic quality, long views
					evaporation		○		
					soil salinity		○		
					soil mantle		◐		
					vegetation		○		
					wildlife		○		
					imported resources		○		

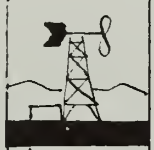
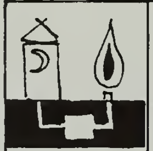
LOCATIONAL CRITERIA	ADAPTABLE TO DESERT	IMPACT		PROCESSES IMPACTED	DESCRIPTION			COMPONENT	ACTION
		NEG.	POS.						
Proximity to settlement areas. Proximity to wastewater treatment. Water availability, low in mineral content. Slopes 0 25%, but level foundations. Proximity to agricultural supplies, transportation. Avoid: areas of aquifer recharge, sensitive vegetation, and wildlife habitat; areas of high scenic quality, long views.	HIGH	○		water quantity	Production of food and fiber by controlled environment agriculture allows intensive cultivation in greenhouses. Increased yields are due to more efficient space utilization, isolation from pests and disease, significantly reduced water requirements, decreased evapotranspirational losses, and lower energy input and cost. Feasibility exists for utilizing brackish groundwater, raw sea water, and sufficiently treated, recycled wastewater.	GREENHOUSE		CONTROLLED ENVIRONMENT	AGRICULTURE (CONT.)
		○		evaporation					
		◐		soil mantle					
		◐		vegetation					
		◐		solar radiation, reflection					
		◐		vegetation					
		○		wildlife					
		◐		imported resources					
		◐		visual quality					
Same as greenhouse criteria.	HIGH	○		water quantity	Production of food and fiber by growing row, garden, field or forage crops with or without an inert medium to provide mechanical support. This soilless medium may be water or a highly permeable aggregate (sand, gravel, vermiculite), and is confined to concrete or other impervious material. A nutrient solution is applied to the beds periodically as a food and water source, and allowed to drain from roots to properly aerate, and recycle through the system.	HYDROPONICS			
		○		evaporation					
		◐		soil mantle					
		◐		vegetation					
		◐		solar radiation, reflection					
		◐		vegetation					
		○		wildlife					
		◐		imported resources					
		◐		visual quality					
Water availability, low in mineral content. Food supply availability, agricultural supplies and transportation. Avoid: areas of aquifer recharge, sensitive vegetation and wildlife habitat; areas of scenic quality, long views; close proximity to settlement.	MOD.	◐		water quantity	Production of food and fiber from introduced livestock and poultry. Factors to consider in determining the suitability of animal production in the desert include water quality and quantity, heat and salt tolerance of the animals, supply or feed and amount of land needed for production and maintenance.	ANIMAL PRODUCTION			
		●		water quality					
		◐		soil salinity					
			○	soil fertility					
		◐		soil mantle					
		◐		vegetation					
		○		wildlife					
		◐		imported resources					
		○		air quality					
		○		noise					
		◐		visual quality					
Located in conjunction with waste water treatment facilities, contolled environment agriculture and consumers of production. Proximity to agricultural supplies, and transportation. Avoid: areas of aquifer recharge; sensitive vegetation and wildlife habitat; areas of scenic quality and long views.	HIGH		●	water quality	Production of food and fiber from introduced species of fish, shellfish and hydrophytes (water plants) in controlled environments. Requires human inputs for production, monitoring, and maintenance. Integration with wastewater treatment facilities allows production of edible fish, shellfish, and plants while recycled water purifies biologically.	AQUACULTURE			
			●	water quantity					
		○		soil mantle					
		○		evaporation					
		◐		vegetation					
		○		wildlife					
		◐		imported resources					
		◐		visual quality					
Proximity to settlement. Located in conjunction with wastewater treatment facilities and compost facilities. Water availability, low in mineral content. Soils should be fertile, have moderate infiltration and low salinity content. Slopes not to exceed 25%. Avoid: areas of aquifer recharge, sensitive vegetation and wildlife habitat; areas of scenic quality and long views.	MOD.	○		water quality	Production of food and fiber by a form of controlled environment agriculture. The method of planting and the plants themselves, combined with organic fertilizers, produce a soil and microclimate which retains moisture, stimulates growth of beneficial subsurface organisms, and a rich nutritional growing medium. With proper practice, soil remains fertile indefinitely and crop yields are four times greater than conventional methods.	 ORGANIC INTENSIVE			
		●		water quantity					
		○		soil salinity					
			●	soil fertility					
		◐		soil mantle					
		◐		evaporation					
		◐		vegetation					
		○		wildlife					
		◐		imported resources					
		●		visual quality					

ACTION	COMPONENT			DESCRIPTION	PROCESSES IMPACTED	IMPACT POS.	IMPACT NEG.	ADAPTABLE TO DESERT	LOCATIONAL CRITERIA
WATER MANAGEMENT	SURFACE RUNOFF HARVESTING	IMPOUNDMENT	CHECK DAMS	Dam constructed in valley or drainage channel for purposes of water, sediment catchment and erosion control. Dams may vary in size and sophistication depending on size of watershed and purpose served. Materials vary: concrete, earth, native stone, brush and debris, reinforced with wire mesh and reinforcing bars.	groundwater recharge		○	HIGH	Natural drainage channel, upstream of desired use. Non permeable soils. Avoid. areas of sensitive vegetation and wildlife habitat, areas of scenic quality, historical, cultural, scientific significance.
					water quantity	●			
					runoff	●			
					drainage patterns		○		
					water logging		○		
					evaporation		●		
					sedimentation	○			
					soil erosion	◐			
					vegetation	◐			
					wildlife	◐			
					imported resources		○		
					visual quality		○		
		DIVERSION	MICRO-CATCHMENT	A series of depressed basins constructed within or adjacent to drainage channels for purposes of water and sediment catchment. Basins may be utilized for agricultural or horticultural purposes. Plants derive water and nutrients as a result of the deep percolation and sediments held in the depressed basins.	groundwater recharge	○		HIGH	Natural drainage channel, in conjunction with agricultural areas. Slope 0 10%. Soils of moderate infiltration. Avoid· areas of sensitive vegetation and wildlife habitat; areas of scenic quality, historical, cultural, scientific significance.
					water quantity	○			
					runoff	○			
					drainage patterns		○		
					water logging		○		
					evaporation		○		
					sedimentation	○			
					soil erosion	○			
					vegetation	●			
					wildlife	◐			
					visual quality	○			
			 KEYLINE	A system of check dams and diversion canals that utilize natural runoff for irrigation and soil conditioning. Check dams are located in valley where slope changes from steep to more gradual. Diversion canals are gravity fed from check dam at slightly higher elevation, across the ridge, to the dam at lower elevation. Runoff is thereby dispersed over the normally dry ridges to irrigate crops and recondition soil.	groundwater recharge		○	HIGH	Locate in valleys/natural drainage channels where slope changes from steep to more gradual. Preferred slope 15-30%. Locate in channels where water velocity is slow to moderate. Locate in conjunction with agriculture and grazing. Prefer impermeable soils. Avoid: areas of sensitive vegetation and wildlife habitat; areas of scenic quality, historical, cultural, scientific significance.
					water quantity	●			
					runoff	●			
					drainage patterns		○		
					water logging		○		
					evaporation		◐		
					sedimentation	○			
					soil erosion	○			
					vegetation	●			
					wildlife	●			
					imported resources		○		
					visual quality		○		
	SUB SURFACE WATER USE		 CONTROLLED	Determination of quantities of underground water reserves and rates of natural replenishment in order that water extracted will not overdraft reserves. Generally, desert underground reserves have taken thousands of years to accumulate to present levels due to slow replenishment rates. Therefore water budget is an essential part of water management policy, if long term water usage is proposed.	groundwater recharge	●		HIGH	Locate in aquifer basins where natural replenishment allows sustained yield. Locate in conjunction with water recycling system that accounts for water requirements and recharges treated wastewater into natural system.
					runoff	●			
					water quantity	○			
					evaporation		○		
					soil salinity	○			
					vegetation	○			
					wildlife habitat	○			
					imported resources		○		
			 UNCONTROLLED	Unlimited use of underground water reserves without regard to rates of natural replenishment or total quantities available.	groundwater recharge		●	LOW	Not feasible, except with imported water supplies.
					water quantity		●		
					evaporation		○		
					water holding capacity		●		
					water logging	○			
					soil salinity		○		
					vegetation		●		
					wildlife		◐		
					imported resources		○		
					visual quality		○		
	RECYCLING		CONVEN. SECONDARY TREATMENT	Waste water treatment that, through settling, filtering, and washing yields water usable in some situations for agriculture and other uses. High organic salt contents may cause problems with plumbing, plant areas, ground water and disease. This water is not drinkable.	water quality	◐		LOW	Proximity to waste generators. Requires importation of energy and materials via utility and pipelines for construction and operation. Proximity to users of waste water and sludge. Proximity to recharge area. Slope gradient 0-3%. Avoid: areas of sensitive vegetation and wildlife habitat; areas of high visual quality, long views. Locate where noise and olfactory pollution will not be a problem.
					water quantity	●			
					soil compaction		●		
					soil mantle		●		
					soil erosion		○		
					vegetation		◐		
					wildlife		○		
					imported resources		●		
					visual quality		●		
					air quality		●		
					noise		●		

LOCATIONAL CRITERIA	ADAPTABLE TO DESERT	IMPACT		PROCESSES IMPACTED	DESCRIPTION			COMPONENT	ACTION
		NEG.	POS.						
Proximity to waste generators. Proximity to users of waste water and sludge. Proximity to aquifer recharge areas. Slope gradient 0-3%. Avoid: areas of sensitive vegetation and wildlife habitat; areas of high visual quality and long views.	HIGH		○	water quality	This process makes use of biological factors to filter waste water. Plants, fish, and microbes participate in this food chain. Under controlled conditions they convert the waste into usable biomass and water, which, after sterilization, is fit for human consumption.	 **BIOLOGICAL**	ADVANCED TREATMENT	RECYCLING	WATER MANAGEMENT (CONT.)
			○	water quantity					
		◐		soil compaction					
		○		soil erosion					
		●		soil mantle					
				water logging					
		◐		vegetation					
		○		wildlife					
		○		imported resources					
		○		visual quality					
		○		air quality					
Same criteria as conventional secondary treatment.	LOW		○	water quality	This process renders waste water completely harmless and it may then be used for any purpose. Unfortunately the process requires a high overhead in construction and maintenance material and energy.	**CONV. ADVANCED TREATMENT**			
			○	water quantity					
		◐		soil compaction					
		●		soil mantle					
		○		soil erosion					
		◐		vegetation					
		○		wildlife					
		●		imported resources					
		●		visual quality					
		●		air quality					
		●		noise					
Soils suitable for structures. Located near native rock supply. Locate in area of prevailing winds; in conjunction with agriculture/settlement, transportation. Avoid: areas of sensitive vegetation and wildlife habitat. Areas of scenic quality, historical, cultural, scientific significance.	HIGH		○	water quantity	Integrated approach to water harvesting and utilization. System involves condensation of atmospheric moisture by convective cooling. Cooling is the result of warm air increasing in velocity as it enters the stone crevices. As the temperature decreases the moisture is lost in the crevices. Water is piped from the pyramids to agricultural areas. A pyramid of 25 meters yields approximately 100 gallons per day. An appropriate desert water harvesting device, if sufficient on site materials are available.	**CONDENSATION**	NEW WATER SOURCES		
			●	evaporation					
		◐		solar radiation, reflection					
		○		vegetation					
			○	wildlife					
		○		imported resources					
		○		visual quality					
Location of resource determined by geohydrological conditions. If poor quality requires desalination process. Desalination requires land, energy, and imported resources.	LOW		◐	water quantity	Underground water that has been unable to migrate for thousands of years due to geologic barriers. Water is often highly mineralized and unpotable. Water is usually found at great depths so extensive costs for drilling pumping may be expected. Purification of water necessitates additional costs. Because of geohydrologic conditions it is considered a non-renewable source of water.	 **FOSSIL WATER**			
		●		water quality					
		○		vegetation					
		○		wildlife habitat					
		◐		imported resources					
		◐		visual quality					
Proximity to energy and material supplies. Natural water availability. Prefer impermeable soils or artificial lining to prevent infiltration loss. Prefer areas of natural holding ponds, avoid areas of sensitive vegetation and wildlife habitat. Avoid: areas of high scenic quality, historical, cultural, scientific significance. Precautions must be taken to not adversely impact areas at lower elevation, due to upstream impoundment.	LOW		●	water quantity	Surface runoff that is impounded by natural and man-made barriers. Natural barriers include impermeable canyons and subsurface bedrock. Man-made barriers include concrete and earthen dams, that are lined with concrete, asphalt, sodium bentonite, plastic and rubber. Because of intense solar radiation, high temperature and low humidity evaporation from surface storage is high. Therefore it is not the most efficient means of surface storage.	**SURFACE**	STORAGE		
			○	water quality					
			●	runoff					
		●		drainage patterns					
		●		evaporation					
		○		solar radiation, reflection					
			●	vegetation					
			●	wildlife					
		◐		imported resources					
		●		visual quality					
Proximity to energy and material supplies for construction and operation. Natural water availability. Soils that can be excavated to desired depth. Prefer impermeable soils or artificial lining. Access to existing roads. Avoid: areas of sensitive vegetation and wildlife habitat; areas of high scenic quality, historical, cultural, scientific significance.	MOD.		○	water quality	Surface runoff that is stored underground either in natural or man-made receptacles. Natural alluvium basins with underlying bedrock can store large quantities of water, although only one-half of water is recoverable due to specific retention. Man-made receptacles are limited in size due to engineering and material costs. Common materials are nylon and plastic bags. Underground storage prevents evaporation losses and resulting increased water salinity.	**SUBSURFACE**			
			●	water quantity					
			●	runoff					
			●	evaporation					
		○		vegetation					
		○		wildlife					
		◐		imported resources					
		○		visual quality					

ACTION	COMPONENT			DESCRIPTION	PROCESSES IMPACTED	IMPACT		ADAPTABLE TO DESERT	LOCATIONAL CRITERIA
						POS.	NEG.		
WATER MANAGEMENT (CONT.)	IRRIGATION	SURFACE	FLOOD	Level crop areas are flooded with water at a rate exceeding the soil infiltration rate. This is generally done by opening gate valves in mainlines or irrigation ditches and containing the flow by means of berms around the crop areas.	water quantity		●	LOW	Proximity to water supply, low in mineral content. Prefer soils of high infiltration and low salinity. Slope gradient 0-3%. Avoid. areas of sensitive vegetation and wildlife habitat; areas of high visual quality and long views; aquifer recharge areas.
					evaporation		●		
					soil salinity		◐		
					soil fertility		◐		
					soil mantle		●		
					vegetation	◐			
					wildlife	○			
					imported resources		◐		
					visual quality		◐		
			SPRAY	An overhead throw of water created by forcing water through a pipe and out of a sprinkler head. These heads create a circular pattern of dispersal that must be overlapped by at least 60 percent with other heads in the system to ensure complete coverage. Water loss is great due to evaporation.	water quantity		●	LOW	Same criteria as flood irrigation.
					evaporation		●		
					soil salinity		◐		
					soil fertility		◐		
					soil mantle		●		
					vegetation	◐			
					wildlife	○			
					imported resources		◐		
					visual quality		◐		
			DRIP	A low pressure system of slowly delivering water to the surface around the base of individual plants by means of small plastic tubing.	water quantity		◐	HIGH	Proximity to irrigation material supplies. Proximity to water supply low in mineral content. Prefer soils of high fertility, moderate infiltration, low salinity. Slope gradient 0-3%. Avoid areas of sensitive vegetation and wildlife habitat; areas of high visual quality and long views.
					evaporation		○		
					soil salinity		○		
					soil fertility		○		
					soil mantle		●		
					vegetation	○			
					wildlife	○			
					imported resources		◐		
					visual quality		○		
			SUBSURFACE	Basically a drip system that has been buried so as to slowly supply water directly to the roots of individual plants. The most water conservative irrigation system.	water quantity		◐	HIGH	Same criteria as for drip irrigation.
					evaporation		○		
					soil salinity		○		
					soil fertility		○		
					soil mantle		●		
					vegetation	○			
					wildlife	○			
					imported resources		◐		
					visual quality		○		
			 DRY-LAND FARM	Use of drought resistant or low water use crops coupled with evaporation reducing measures. These measures lower the surface temperature and are commonly in the form of rock or other types of mulching.	water quantity		○	HIGH	Locate in areas of highest natural precipitation. Locate in or near drainage channels where possible. Slope gradient may vary up to 16%. Prefer soils of high fertility, moderate infiltration, low salinity. Imported resources necessary for artificial mulches to reduce evaporation. Avoid: areas of high watershed value, sensivite vegetation, and wildlife habitat; areas of high visual quality and long views.
					evaporation		○		
					soil fertility		○		
					soil mantle		●		
					soil salinity		○		
					soil erosion	○			
					vegetation	○			
					wildlife	○			
					visual quality		○		
					Imported resources		○		

LOCATIONAL CRITERIA	ADAPTABLE TO DESERT	IMPACT		PROCESSES IMPACTED	DESCRIPTION			COMPONENT	ACTION
		NEG.	POS.						
Energy generation is dependent upon local resource deposits or importation of the resource Proximity to major and minor transportation routes. Possible negative impacts to air quality, restrict locations where air quality hazards are minimized Noise pollution restricts location adjacent to preservation, passive recreation and settlement areas. Avoid: areas of aquifer recharge, sensitive vegetation and wildlife habitat; areas of high scenic quality.	LOW	○ ◑ ● ◑ ◑ ○ ● ● ● ●		water quantity runoff soil mantle soil compaction vegetation wildlife imported resources air quality noise visual quality	Generation of power by burning of any fossil fuel except natural gas. They are limited, non renewable resources whose importation would be required at increasing cost over time Dependency on its availability would be unwise	FOSSIL FUEL	ELECTRICITY	CONVENTIONAL	ENERGY
Locate in isolated area because of radiation hazards. Requires large amounts of imported resources for construction and maintenance. Locate where large supplies of wind or water are available for cooling process. Avoid areas of known fault zones; aquifer recharge areas, sensitive vegetation and wildlife habitat; areas of highly erodable soils. Soils suitable for structures. Proximity to major and minor transportation routes.	LOW	● ● ◑ ● ○ ◑ ○ ● ●		water quantity water quality runoff soil compaction vegetation wildlife imported resources visual quality	Use of atomic energy in powering steam turbines to generate electricity. Sometimes the energy and resources necessary to construct and maintain a power plant exceed the energy generated. Nuclear plants are not entirely safeguarded against accidents.	 NUCLEAR			
Energy generation is dependent upon local resource deposits or importation of the resource. Requires large amounts of imported resource for construction and maintenance. Health and safety hazards necessitate location away from settlement. Avoid: areas of highly erodable soils. Soils suitable for structures needed. Proximity to major and minor transportation routes. Avoid· areas of aquifer recharge, sensitive vegetation and wildlife habitat.	MOD.	◑ ● ○ ● ◑ ○ ● ●		runoff soil compaction soil erosion soil mantle vegetation wildlife imported resources visual quality	Use for either direct heating or to power steam turbines for generation of electricity. In combustion, pure natural gas burns clean. It is a limited, non-renewable resource whose importation would be required at increasing cost over time.	NATURAL GAS			
Dependent upon available natural water source or based upon routing of imported water source. Soils suitable for structures. Avoid areas of known fault zone. Requires large amounts of imported resources for construction and operation. Proximity to major and minor transportation routes. Avoid: areas of highly erodable soils, sensitive vegetation and wildlife habitat; areas of scenic quality, cultural, historical or scientific significance.	MOD	○ ○ ○ ○ ● ◑		runoff soil erosion vegetation wildlife imported resources visual quality	Moving water is used to power turbines for generation of electricity. Construction of dams is usually necessary to provide enough head to turn the turbines. If the generators are not local, large power lines must be brought into the area	HYDRO ELECTRICITY			
Prefer southern slopes and aspects. Requires Imported resources for construction. Avoid. areas of sensitive vegetation and wildlife habitat; areas of high scenic quality or long views.	HIGH	● ○ ○ ○ ●	 ●	soil mantle solar radiation, reflection vegetation wildlife imported resources visual quality	Use of sun's energy requires large collection areas. Desert provides maximum solar radiation as energy source. A passive system.	 HEATING/ COOLING	SOLAR	ALTERNATIVE	
Locate in close proximity to users. Prefer southern slopes and aspects. Requires imported resources for construction. On flat terrain, locate in slight depressions to minimize visual impact. Avoid: aquifer recharge, sensitive vegetation and wildlife habitat; areas of high scenic quality, long views, historical, cultural or scientific significance.	HIGH	● ○ ○ ○ ●	 ●	soil mantle solar radiation, reflection vegetation wildlife imported resources visual quality	Could substitute for conventional electricity but is expensive at present time.	 ELECTRICITY			

ACTION	COMPONENT			DESCRIPTION	PROCESSES IMPACTED	IMPACT		ADAPTABLE TO DESERT	LOCATIONAL CRITERIA
						POS.	NEG.		
ENERGY (CONT.)	ALTERNATIVE		 WIND	Use of wind to power pumps, generators, and cooling towers. The potential for wind power has not been fully realized.	soil mantle		●	HIGH	Locate in close proximity to users Locate in path of prevailing winds Design should minimize visual impact. Imported resources required for construction and maintenance. Avoid. areas of sensitive vegetation and wildlife habitat, areas of scenic quality, long views, cultural, historical, scientific significance.
					vegetation		○		
					wildlife		○		
					imported resources		○		
					noise		○		
					visual quality		◑		
			 BIO-FUELS	Production of methane via decomposition of organic wastes. Substitutes for conventional natural gas.	water quality		○	HIGH	Locate as component of waste recycling system (i.e. sewage, organic wastes). Proximity to waste generators and users of waste by-product. Precautions must be taken to minimize health and safety hazards (combustion of methane gas). Avoid location in path of prevailing winds; areas of aquifer recharge, sensitive vegetation and wildlife habitat; areas of high scenic quality, long views, cultural, historical, and scientific significance.
					water quantity	○			
					soil mantle		●		
					vegetation		◑		
					wildlife		○		
					imported resources		○		
					noise		○		
					air quality		◑		
					visual quality		●		
			GEOTHERMAL	Power produced from steam and heated water from beneath the surface of earth that turn generators which produce electricity.	water quality		◑	LOW	Energy generation is dependent upon presence of geothermal deposits. Imported resources necessary for construc and operation of plant. Isolated location preferred because of thermal, air, visual and water pollution. Proximity to major transportation. Avoid Aquifer recharge areas, areas of sensitive vegetation and wildlife habitat; areas of high scenic quality, long views, cultural, historical and scientific significance
					water quantity		◑		
					soil mantle		●		
					vegetation		◑		
					wildlife		◑		
					imported resources		●		
					noise		●		
					air quality		●		
					visual quality		●		
CIRCULATION	ROADS		PAVED	A hard impermeable surface for vehicle transportation, usually of hardened asphalt of concrete They require varying depths of improved sub-grade. Paved roads can be level to 20+ percent depending on length and type of use.	groundwater recharge		○	MOD	Proximity to settlement and active recreation location dictated by topography. Preferred garient 0 8%. Imported resources required for construction and maintenance. Location should provide visual interest for drivers. Avoid highly erodable soils, areas subject to landslides or flash flooding, areas of aquifer recharge; sensitive vegetation and wildlife habitat; areas of high visual impact, long views
					runoff		○		
					evaporation		◑		
					soil compaction		●		
					soil erosion		○		
					solar radiation, reflection		○		
					vegetation	○			
					wildlife	○			
					imported resources		○		
					visual quality		◑		
			UNPAVED	Graded or ungraded road that has minimal visual impact. May have earth surface or other permeable material such as gravel or oiled dirt.	groundwater recharge		○	HIGH	Proximity to settlement and active recreation. Location dictated by topography, preferred gradient 0 8% Location should provide visual interest for driver. Avoid highly erodable soils; areas subject to landslides or flash flooding, areas of aquifer recharge, sensitive vegetation and wildlife habitat, areas of high visual impact, long views.
					runoff		○		
					soil compaction		●		
					soil erosion		◑		
					vegetation	○			
					wildlife	○			
					imported resources		○		
					visual quality		○		
	PATHS		EQUESTRIAN/ HIKING	Minimum site modification. Rudimentary improvement may be necessary in inaccessible sections of trail system and where trail stabilization is required. Potential for impact is greater than hiking trails.	runoff		○	HIGH	Proximity to settlement, active and passive recreation areas. Location is based upon demand of users. Location is dictated by topography. Gradients up to 30% allowable except in areas of highly erodable soils. Avoid. lengthly southern exposures without provisions for rest, water and shade Path should provide visual interest for rider. Avoid areas subject to flash flooding or landslides, areas of sensitive vegetation or wildlife habitat,
					soil compaction		○		
					soil erosion		○		
					soil mantle		○		
					soil fertility	○			
					soil salinity		○		
					vegetation		○		
					wildlife		○		
					visual quality		○		

PART D

CASE STUDY: DESERT SLOPE

The planning study described in this chapter demonstrates many of the procedures and techniques explained in prceding chapters. The area studied, on the eastern slope of the San Bernardino Mountains, is one in which the perplexing issues of land tenure adjustment exist in abundance. The unusually complex conditions there demanded a somewhat rigorous and thorough analysis—more detailed than is likely to be required in many parts of the California Desert. Careful review of this example will especially serve to clarify the land suitability determination step of the land tenure adjustment process, and can provide a model for future efforts in other planning units.

This area includes within its 680 square miles a wide range of ecological, social, political and economic issues which are common to the California Desert Conservation

Area, and which combine to form major management problems for the Bureau. In particular, the public lands within the site are presently subjected to intensive, uncontrolled use, often to the detriment of the environment. Prior public land sales programs have created a complex pattern of land ownership. Public lands have become surrounded by private holdings, ownership boundaries are indistinct, and private lands occur within large tracts of public domain.

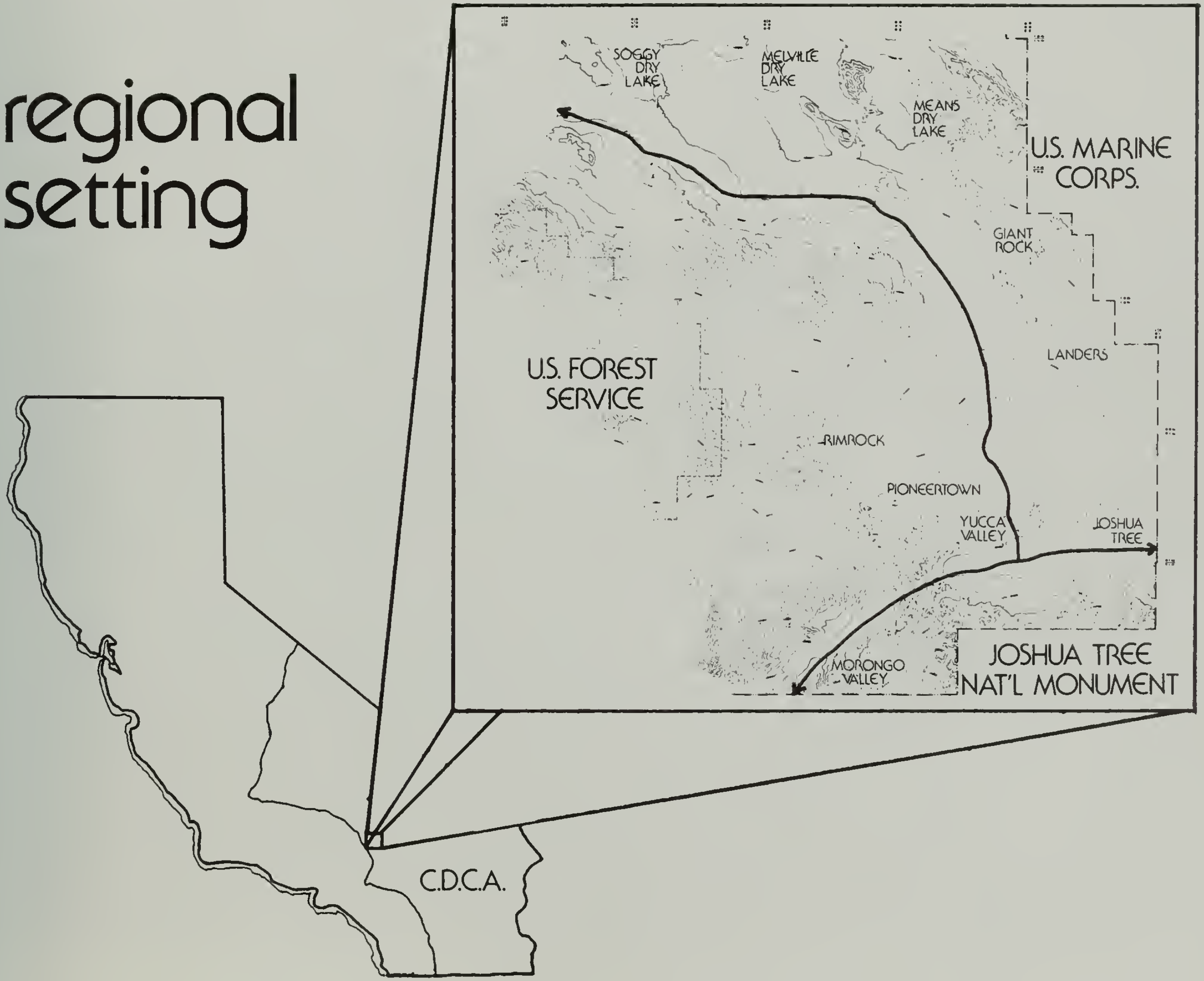
An extensive program of land tenure adjustment will be needed to address these problems in the Desert Slope area. A systematic pattern of decisions will be required in determining which public lands should be disposed of for private use, which lands should remain in public domain, which lands should be reacquired by the BLM and how public lands should be managed. The work described here gives a rational basis for that pattern of decisions, and does so in a way that satisfies the planning and environmental analysis requirements of FLPMA and NEPA.

REGIONAL SETTING

The Desert Slope Program Area is located in the southwest portion of the Mojave Desert in San Bernardino County, within the California Desert Conservation Area under study by the BLM. The boundaries of the selected area were determined by physiographic factors and by the boundaries of federal land holdings other than those of the Bureau.

On the north, west, and south, important ridgelines of the San Bernardino Mountains and other geomorphological features delineate the site as a distinct regional watershed. Consideration of the whole watershed led to inclusion of some area that is under the jurisdiction of the United States Forest Service. This has

regional setting



implications for inter-agency planning coordination of a type that will increasingly be required under FLPMA and the new NEPA regulations. However, the goals and policies of the BLM and Forest Service substantially coincide for these purposes, and it is appropriate that the Bureau and the Service should cooperate in planning for such areas of overlapping concern.

The east and southeast limits of the study area are formed by the boundaries of the U.S. Marine Corps Training Facility and the Joshua Tree National Monument. These boundaries have little effect on the ecology of the study area, but the Marines and National Park Service, like the Forest Service, also have goals and policies to be considered in any land use proposal which may impact their lands. Planning coordination is therefore indicated on these boundaries as well.

The Desert Slope is in close proximity to the Los Angeles/San Bernardino megalopolis and is heavily used as a recreational outlet for regional populations. It is served by two major highways: State Highway 62 which provides access from the southwest, from the Twenty-nine Palms area; and Old Woman Springs Road, which enters from the northwest (Lucerne Valley and Victorville) and terminates in Yucca Valley. Coordination with the State as well as local authorities will be required in planning access and circulation for any major changes in land tenure.

A highly important matter for coordination with the State results from the possible routing of the proposed Coachella Valley aqueduct through this area, or alternatively, the extension of water service to the area by the Mojave Water Agency. In either case, the access provided to Northern California water sources would have major impact on the Federal lands. Therefore, thorough analysis of the type indicated here will be required prior to granting lands for this purpose, or any rights-of-way through BLM-controlled areas.

HISTORICAL SETTING

The Desert Slope Study Area has hosted many uses and groups of residents. Historically, the Serrano, Chemehuevi, and Morongo Indians occupied lands around springs and waterholes. The early pioneers, arriving before the turn of the century, were prospectors and cattlemen. Gold, silver, and platinum were mined for several decades. Grazing was a primary use through 1945 before much permanent settlement occurred. Throughout these latter periods, the vast majority of land in the study area was in public domain.

Land first become extensively available for private ownership with passage of the Small Tract Act of 1938. There was little investment in these properties prior to World War II. However, around 1950, the situation changed due to the rapidly expanding population of Southern California. This, coupled with the BLM Land Sale and Lease Program, formed the basis for the ensuing land rush. Beginning in the 1950's, the Bureau offered 5 acre parcels for lease at a cost of $5.00 per year. After 5 years, the leasee would own the land if he had made certain improvements. These "improvements" basically entailed building a house of at least 400 square feet. Eventually the BLM's direct sale policy abandoned the improvement contingency, in part because of the proliferation of unoccupied buildings.

This activity resulted in an estimated 75,000 5 acre parcels sold or leased in the study area during the 1960's. The program continued with more sales until 1972 when the BLM halted land disposal activities in order to begin comprehensive planning.

Only one in five applicants ever made improvements, even when they were required. Many properties were difficult to locate, not served by roads or utilities, and costly to improve. Water, if available at all, required expensive drilling. Of those houses or shacks that were built, many have been abandoned and are still visible, contributing to a badly scarred landscape. Furthermore, a large proportion of lots remain vacant and may never be used.

A primary motivation in purchasing these lands was speculation. Often, no improvements were intended. Indeed, few lots have shown a gain in real value, and this has contributed substantially to the vacancy rate. It seems likely that there will continue to be large numbers of vacant lots through the turn of the century.

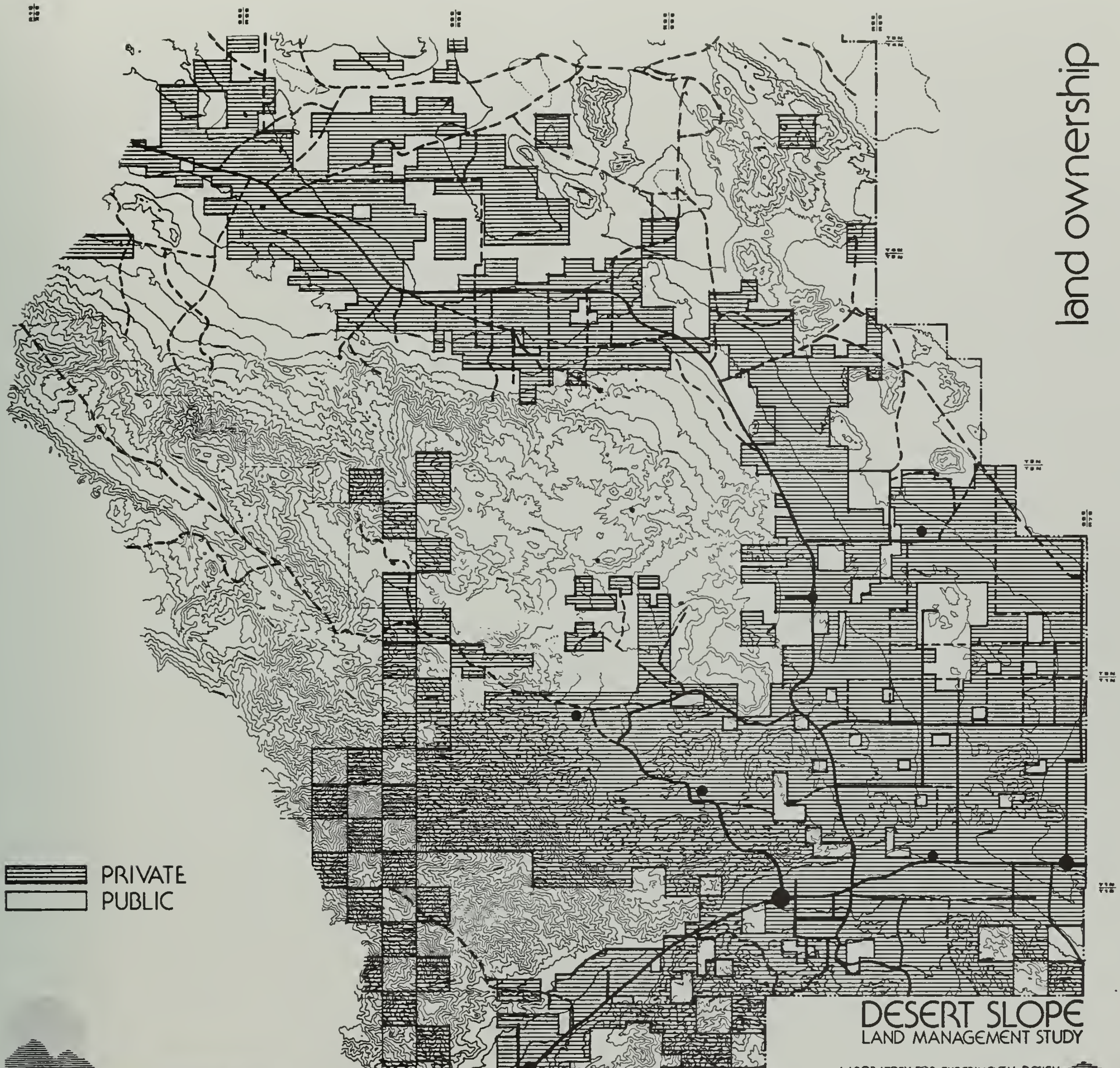
Those buyers who were not motivated by speculative interest, and who acquired buildable properties with good location, use their land primarily for retirement or for recreational retreats. In this regard, the present study area contains the third largest concentration of second homes in California. With the recreation potential of adjacent public lands, and given adequate, economic scources of water and other utilities, recreational and residential use can be expected to increase.

THE PRESENT PROBLEM

The historic record of land sales in the study area has led to a complex pattern of ownership (see ownership map). In attempting to develop a comprehensive resource inventory and land use plan, the BLM is faced with a troublesome "checkboard" pattern. For all the reasons listed in Chapter A-I, public lands that are surrounded by or adjacent to uncontrolled private lands present serious problems to the successful administration of an ecologically sound and resource-oriented land use plan.

In determining the appropriate forms and locations for use in this or any arid land study area, regional ecological balances should be emphasized as the basis

land ownership



for determining carrying capacities and directing land use managment. Any use must respect and maintain the productivity of the fragile desert ecosystems.

A variety of complex critical concerns must be dealt with if human use is to be symbiotically placed within this desert environment. These factors include:

- availability of water (native and imported)
- natural vegetation and wildlife
- soil characteristics
- visual quality
- political goals and policies
- public opinion and demand
- environmental impact (on resources and natural flows and cycles).

At the top of the list is water. This has been the single factor most limiting to human use of desert land, just as it is the limiting factor on natural vegetation, soil, and wildlife. If water were more readily available, much more development would take place. This is especially true due to the region's proximity to the expanding Southern California megalopolis. Proposed extension of aqueduct water to the area would have potentially dramatic impact here, as it has had in the Coachella Valley, south of the study area, which is currently being artificially supported in its arid environment by the Colorado River aqueduct.

It is the belief of this project team that planning for the Desert Slope area should be based primarily on the carrying capacities of local ecosystems and not only on the potential for imported water. Without a water limitation, population would expand rapidly, and conventional, inefficient water management practices (e.g. spray irrigation, septic tanks) would be perpetuated, creating an import-dependent pattern of land use. Introducing a "dependent environment" into an ecosystem incapable of supporting it is inadvisable. The recent two year drought has shown that Northern California water is not inexhaustible. Even in good years the supply is limited, and in any case the price is certain to rise steeply in the 1980s. It is not known at what point the resource will be overextended, but the fact that Los Angeles was cut off at the height of the drought indicates that this water may not always be available. Therefore, planning for human habitation should rely on existing natural processes as much as possible. Water for life support in particular should be derived from the local hydrologic cycle if possible. The present study shows that such a requirement is compatible with further development within the study area.

If imported water is made available, it may allow irrigated agriculture in the study area where none is possible now. Likewise, this water could be used to support recreational activities in much more developed forms than are presently possible. Such import-dependent activities would be highly impacted if the water source later failed. However, if actual life support supplies were obtained from sources within the region, desert settlement could continue without fear of critical water shortage.

BASES FOR DECISIONS

The framework for planning and decision-making to resolve the land use, ownership and management problems of the program area embraces three major areas of concern: the political context, the socioeconomic factors and the physical environment.

Giving direction to all plans and decisions concerning the California Desert are the policies of the federal government as described in Chapter AII. The several federal agencies that have jurisdiction within this program area and adjoining it are all guided by the same policies, and will find it necessary to cooperate in carrying them out.

As explained in Chapter BIV a number of local agencies are also involved. In the Desert Slope area these include the following:

COUNTY OF SAN BERNARDINO
- Planning Department
- Road Department
- Office of Community Development
- Flood Control District
- Yucca Valley Municipal Advisory Council

SCHOOLS
- Morongo Basin Unified School District
- College of the Desert

PUBLIC SAFETY
- Joshua Tree County Fire District
- Morongo Valley County Service District
- Yucca Valley County Fire District

WATER RESOURCES
- Water Quality Control Board, Colorado Region
- Colorado Region State
- Mojave Water Agency
- High Desert Water Company
- Joshua Tree County Water District
- Hacienda Heights Association
- Little Morongo Heights Water Company

Morongo Valley Water Company
Southern California Water Company
Yucca Valley Water Company

Within this politicl context, plans and decisions are required to consider the attitudes and opinions of the citizenry. Several opinion polls have been conducted in conjunction with the BLM Desert Planning Program to determine public attitudes toward the desert and its use. These have shown a consistent and widespread public preference for protecting the ecological systems of the desert.

At the same time demands have been expressed for human use of the land in this area. Given the proximity to major urban areas and the very large amount of land under consideration, these demands cannot easily be ignored. Demands are primarily for recreational, residential and agricultural uses, and these are the uses that will be considered here.

Both the political context and the socioeconomic factors underscore the paramount importance of the physical environment, and the necessity of understanding and working with it in planning for use of the desert. An understanding of the natural processes and resources of program areas, and their capacity to support human use depends on having answers to several questions: What are the key ecological processs which make the land function productively and keep it balanced and vibrant? What is the full range of resource components (soil, vegetation, hydrology, etc.)? What effect would various uses have on natural functions and the resource base? With an understanding of these issues, use potentials and constraints can be determined and the effects of projected use can be appraised.

Analysis of the physical environment utilizes certain interpretive tools. The first to be applied in this situation is the construction of conceptual models of the regional ecosystem. These provide a framework for determining the impact implications of any use, and become a guide for selecting uses that are most compatible with natural cycles and flows. In this way, man's activites can even be beneficial to the ecosystem, as well as to himself.

The second tool is the resource inventory, which graphically illustrates the components of the total ecosystem. Climate, hydrology, soil, flora, fauna and historic, cultural and visual character determine constraints and opportunities for human use.

Once these two tasks have been performed, a listing of the critical sensitivites, opportunities, and constraints based on the total ecosystematic analysis can be compiled for eventual use in determining and locating adaptable and appropriate uses.

Having established the types of uses to be considered in the program area, each potential use can be studied with respect to the physical environment. For each use, an anlysis determines probable impacts on the environment, locational criteria, feasible mitigation techniques, and overall adaptability of the form to the landscape. By this means, uses and forms which have high impact and are not adaptable can be eliminated from consideration. Based upon locational criteria determined in the previous analysis, land use suitability mapping can be carried out. A suitability map is generated for each potential use.

Potentials for multiple use are determined by overlaying individual suitability maps. This technique results in a composite suitability map that shows the potentials for use. It is entirely possible that two or more use categories, and their various forms, may be located within the same tract of land. This opens up many possibilities for integrated communities, interrelated uses and a generally cohesive pattern of land use.

In response to the composite suitability map, management guidelines can be developed specific to each type of suitability designation. For example, the management of areas designated "Preservation/Passive Recreation" or those suitable for "Agriculture and Settlement" will be managed in different ways. The former might require public ownership and visitor control, orientation, and education by the BLM. The later might indicate the desirability of sale or lease of public land to private interests with proper controls placed in the agreement to insure proper uses and forms.

For these reasons, in cases such as this where there is a previously imposed pattern of ownership and control, additional mapping should be prepared which will indicate to the public land agency involved which lands should be transferred to private control. Such mapping will indicate to the custodial agency how the ownership patterns should look based on sound ecological, social and political analysis.

ECOSYSTEM ANALYSIS

The Desert Slope Study Area offers considerable potential for housing, commerce and recreation. Agriculture is also drawn to the area because of its long growing season and maximum solar radiation. By careful planning, these uses can be integrated into the specific ecological conditions of the desert environment. Those uses which serve to stabilize the material and energy flows and cycles inherent in desert ecology should be considered most feasible. While comparatively little work has previously been done in the detailied measuring of climatological, hydrological, vegetative or edaphic factors in the study area, general models can be constructed. These models can aid in planning because they show how the components of desert ecology function and interact to form the unique desert environment.

The ecology of the study area is limited by the climatic factors of precipitation and temperature. A marginal supply of water and extremes in temperature result in the various forms of vegetation and soil found on the desert slope.

Seasonal and diurnal variations in temperature create a stressful environmental condition. Summer highs frequently exceed 100° F. Winter lows range below freezing to an extreme of 15° F. The diurnal temperature fluctuation can exceed 40° F.

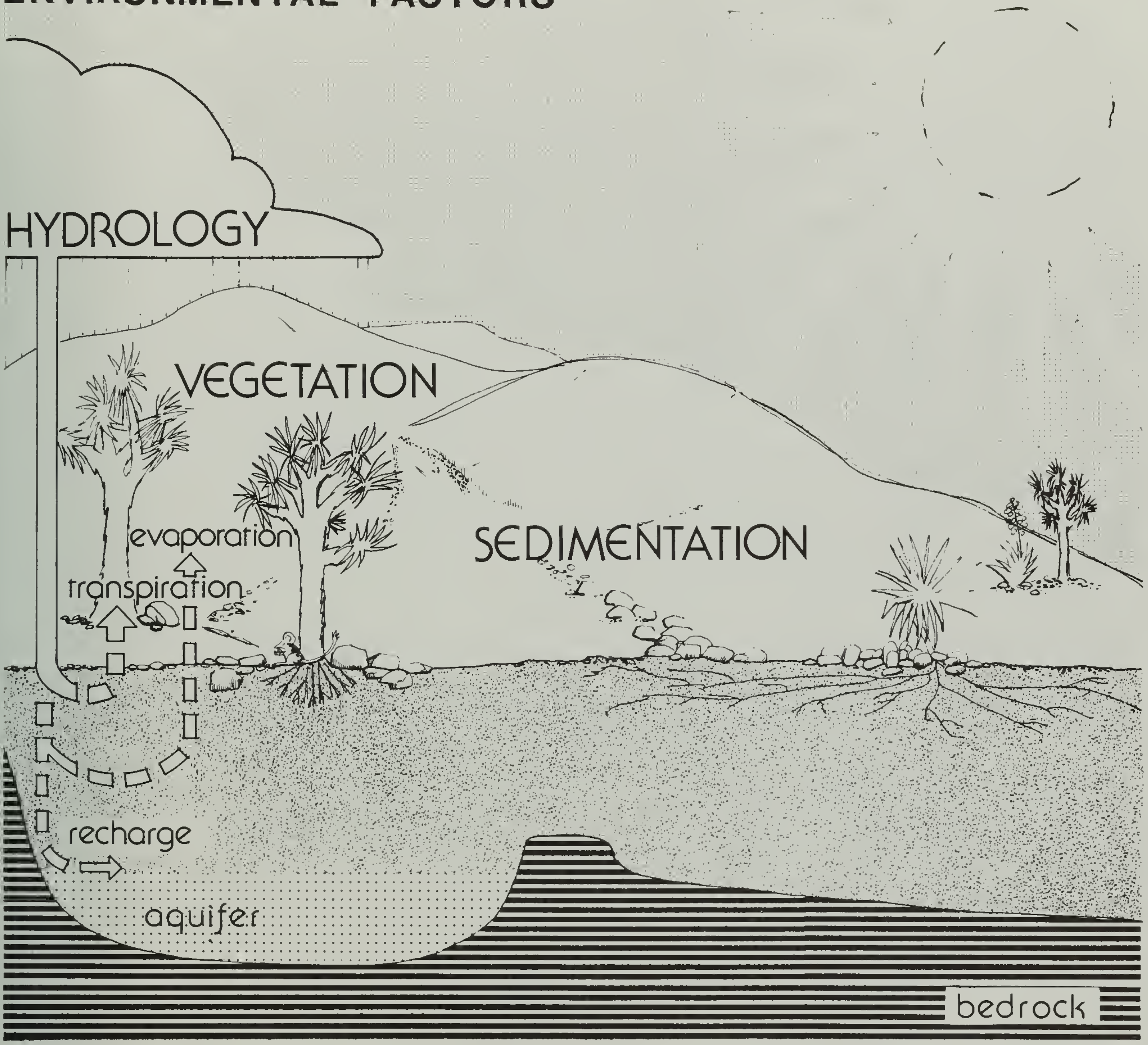
Precipitation rates are a function of elevation. Amounts range from 16" in the highest elevations to less than 4" in the valleys. With regard to natural systems, however, an important factor is the seasonality of precipitation. Most precipitation occurs during the winter months (November—April). A prolonged dry season, which corresponds to the growing season of most native plants, is a limiting force on growth rates and resiliency.

Within this climate framework, the ecology of the study area is most easily considered in terms of hydrology, sedimentation, and biotic factors. Since elevation and slope characteristics are so vital to an understanding of the processes, the mapping of these factors is included here. From this information, a cross-sectional format has been adopted to illustrate the hydrologic, sedimentation, and biotic processes of the desert slope.

HYDROLOGY

The meager rainfall conditions of the study area are the result of the rain-shadow effect produced by the San Bernardino mountains. However, considerable precipitation spills over the ridgeline and falls at the high elevations. This water eventually supplies the aquifers of the desert valleys.

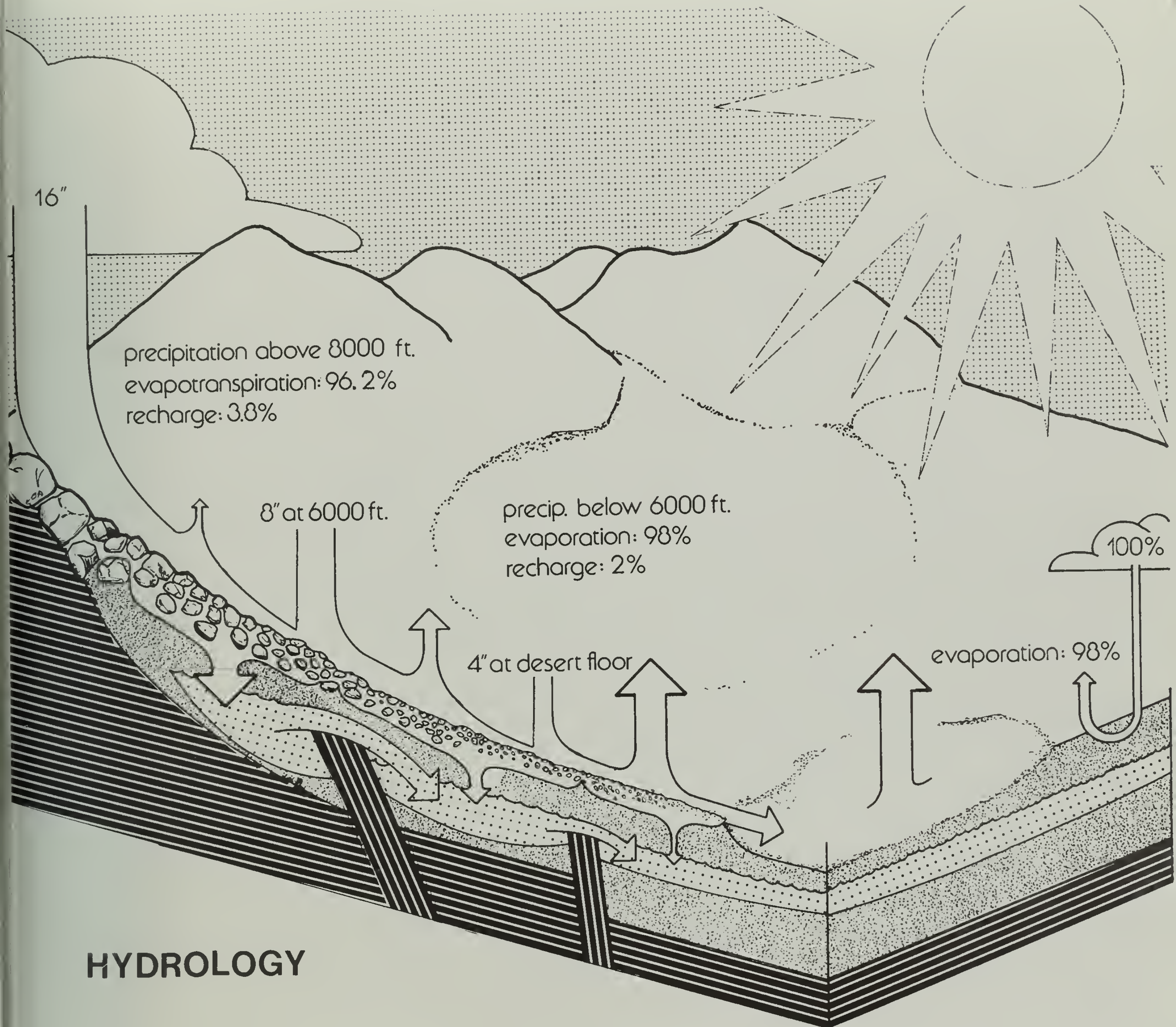
ENVIRONMENTAL FACTORS



Rainfall or snowmelt from the mountains begins its descent to lower elevations if it is not consumed by vegetation. At the higher elevations, due to steep topography, loss of water through infiltration is low. As the water travels down the mountain washes, a portion of it is consumed by riparian vegetation or evaporates away. As lower elevations are reached, the slope decreases and the stream beds are characterized by increasingly deep permeable deposits. It is from this point to the top areas of the alluvial fans that most infiltration of runoff occurs. The soils in the stream beds and high on the alluvial fans are very permeable.

At this juncture, the functional difference between snow and rainfall must be stressed. Rainfall, as stated, often occurs in the form of intense storms. Under such circumstances, runoff is rapid and often results in flash floods. Due to the rapid transmission of water through the stream channels and washes, only a small percentage can infiltrate. Most ends up in the dry lakes where it evaporates. On the other hand, snowmelt allows for the slow release of water to the stream beds where much of it is infiltrated. Loss only occurs via evaporation and transpiration by riparian plants. This condition points out that, of the estimated 16" of precipitation occurring in the mountains, that in the form of snow contributes most significantly to underground storage. This fact is responsible for the low actual recharge amounts characteristic of desert hydrology.

Once underground, via percolation in steam beds and alluvial fans, water migrates downslope to fill the alluvial basins. Some of these basins are up to 700 feet in depth. After reaching a basin, water moves slowly under pressure through the alluvium and migrates down slope into basins at progressively lower elevations. The transmission rate of water may vary depending on the pressure and permeability of the groundwater barriers (faults, bedrock upwelling, etc.) which separate the


16"
precipitation above 8000 ft.
evapotranspiration: 96.2%
recharge: 3.8%
8" at 6000 ft.
precip. below 6000 ft.
evaporation: 98%
recharge: 2%
100%
4" at desert floor
evaporation: 98%

HYDROLOGY

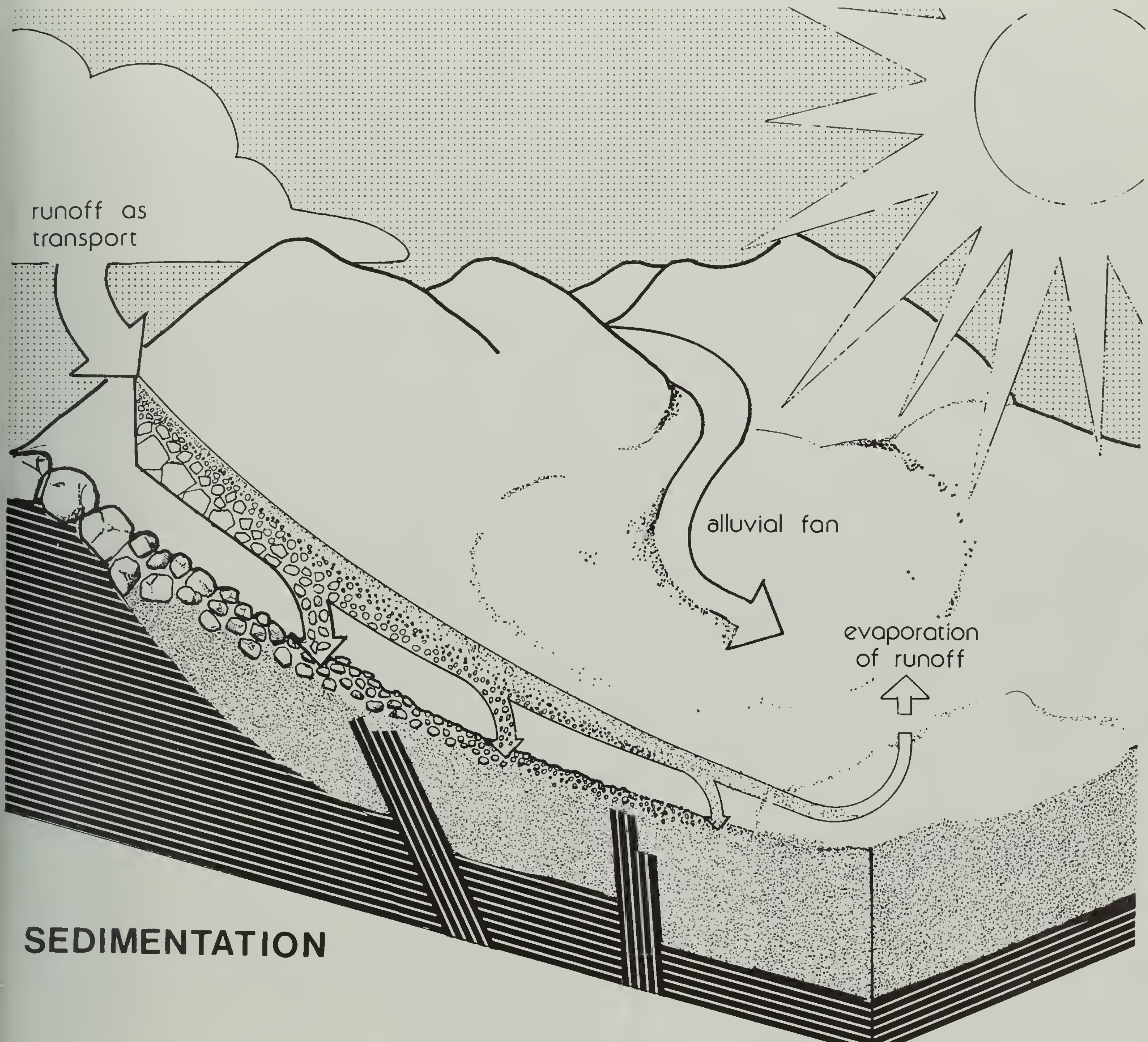
basins. As the water travels down-slope, it picks up concentrations of soluble minerals and becomes increasingly saline.

Most beneficial precipitation for support of this underground process occurs above 6000 feet. Below this elevation, rainfall averages less than 8" annually. Under these circumstances, most precipitation is lost to evapotranspiration. Rainfall occurring on the less permeable soils of and below the alluvial fans, quickly saturates the top 6-18 inches of soil where it is usable by plants. The rest runs off. It is estimated that only about 2% of this water ever reaches the underground storage basins.

In conclusion, only a low proportion of precipitation occurring in the study area enters the aquifers for storage. The amounts used to support flora and fauna take up a significant proportion, but a likewise significant proportion is lost from the system via rapid runoff and evaporation. Due to this inefficiency in the system, it is apparent that sensitive human intervention in controlling runoff for use and underground storage can increase the existing carrying capacity of the study area. To accomplish this, human settlements would best be located along the major washes at the middle elevations below 6000 feet but above the desert floor.

SEDIMENTATION

The source of desert soil material lies in the rock of the surrounding mountains. This rock is exposd to many types of mechanical and chemical weathering and over time is broken down into many differently sized particles. From the mountains to the desert floor, water serves as their transportation vehicle. When rainstorms occur in the mountains much of the eroded material is washed out onto the desert slope. As the torrent exits the mountain face, its velocity and carrying capacity are reduced as the


runoff as transport
alluvial fan
evaporation of runoff
SEDIMENTATION

area over which it flows increases. Large bits of sediment begin to settle first and, as the stream fans out, a cone of graded materials is formed. This cone is commonly called an alluvial fan.

The erosive soils of the alluvial fan are subject to gullying and rapid changes. Any disturbance, natural or man-made, magnifies the erosive potential of the alluvial fan. The rocky sediment at the apex of the cone has a high infiltration capacity and serves as a major recharge area for underlying groundwater basins. There is a corresponding decrease in infiltration capacity as particle size diminishes to the point of negligible percolation in the sinks.

Desert soils are immature and lack organic content because of high heat and consequent reduced microbial activity. Mountain soils are better developed than the lower elevation alluvial soils because of higher rainfall and denser vegetation. These circumstances allow for more microbial activity in decomposing organic matter to humus. While the alluvial soils are deeper than mountain soil, the actual development is far less. High heat, poor moisture conditions and low vegetative cover have resulted in less than 1% organic matter.

While water is the major factor influencing soil texture, erosion, and salinity in desert soils, wind is also an influential force. Hot and dry winds are characteristic of the study area. Sparse vegetation and vegetation and topography intensify its effects. Little organic matter and the lack of moisture make wind erosion a problem. Exposed or damaged soils are as easily eroded by wind as they are by water.

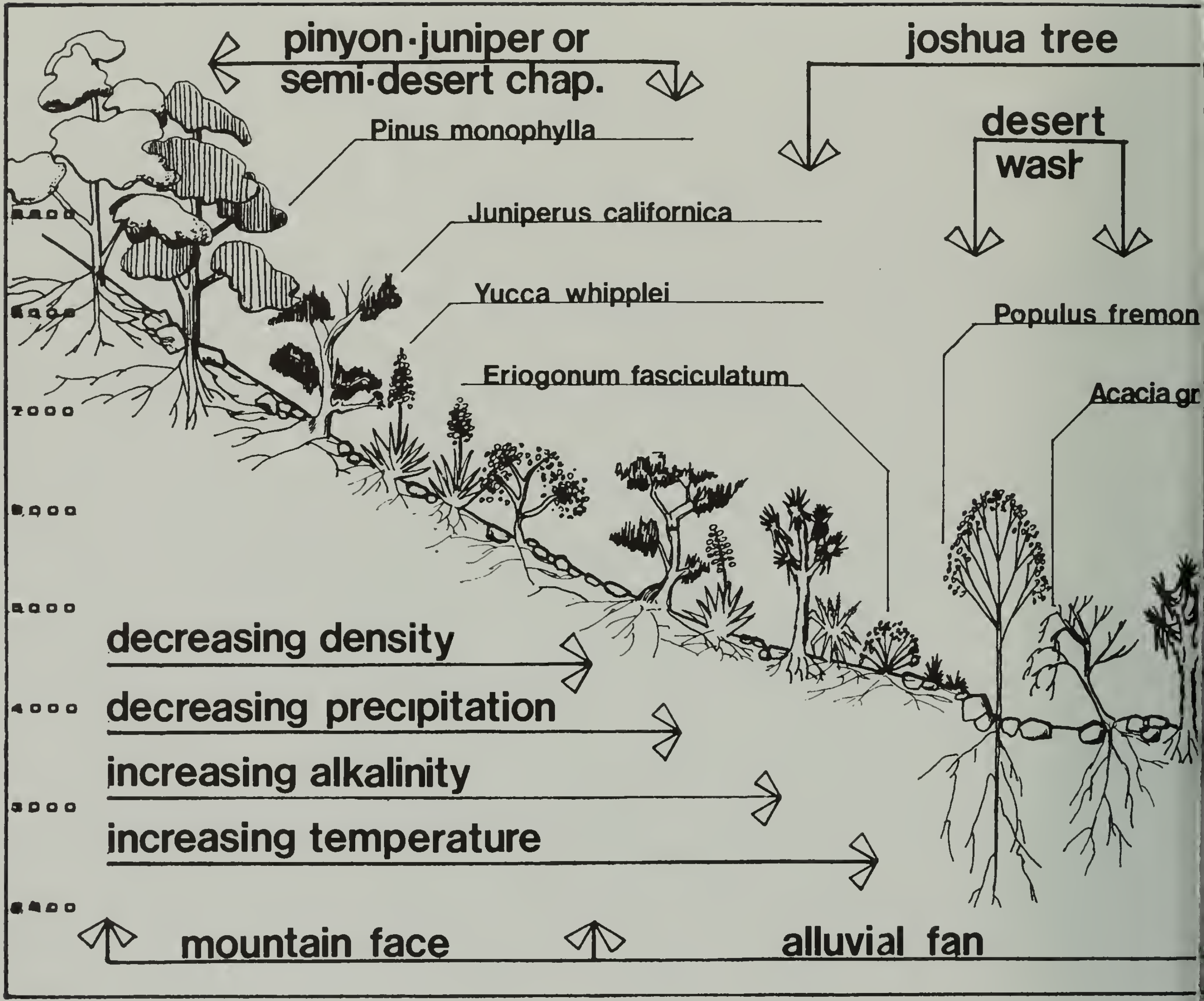
VEGETATION

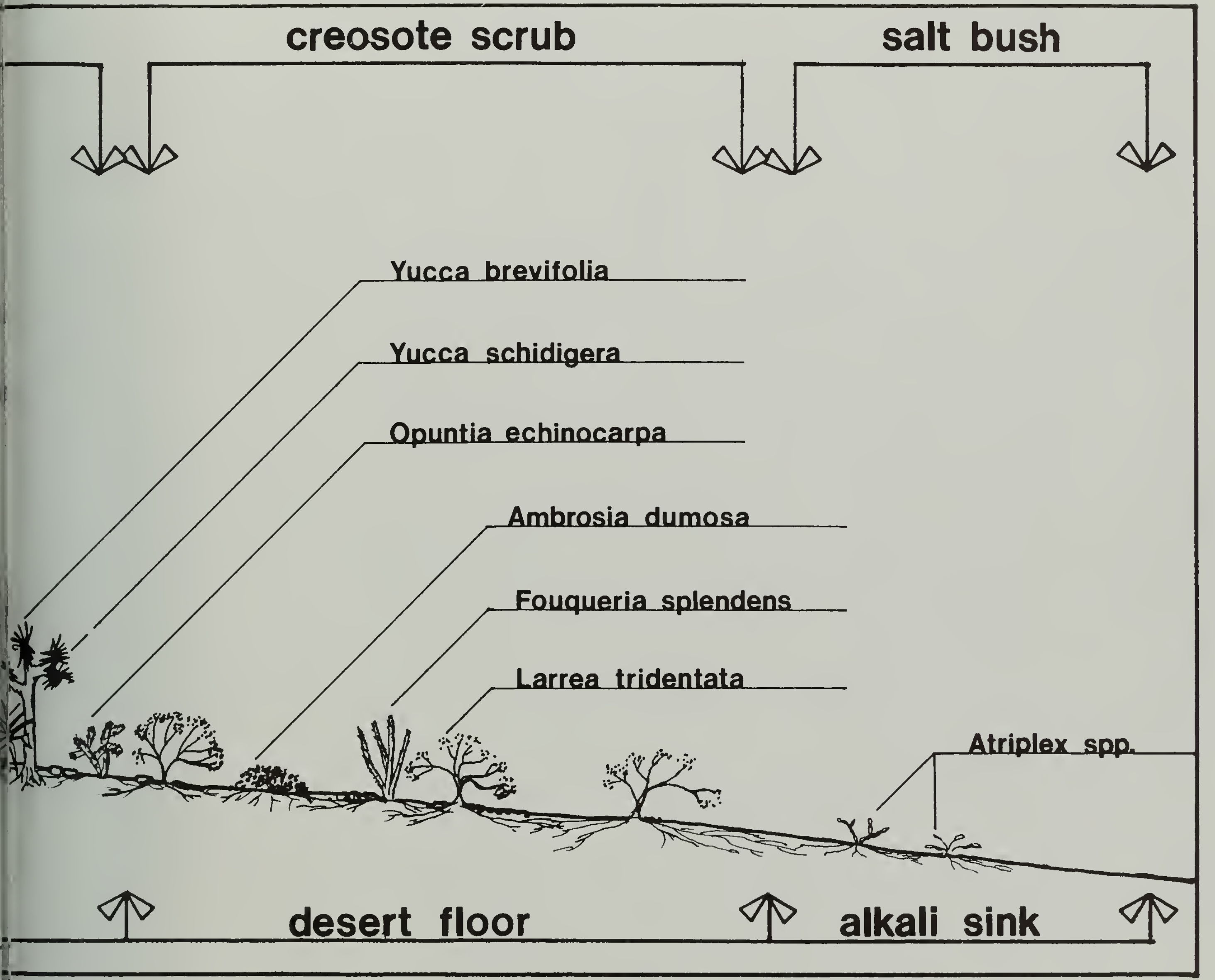
Climate, hydrology and soils combine to determine the distribution of vegetation. Again, elevation serves as a major foundation.

At higher elevations, where temperatures are lower, precipitation is higher, and soils can be more developed, vegetation is dense and diverse. As lower elevations are considered, progressively less dense and diverse vegetation is encountered. At the lowest points on the desert floor, temperatures are extreme, moisture is in short supply, and soils are poorly developed. The result is a sparse and uniform plant cover. Individual plants, by use of toxins and extensive surface root systems, define large territories to insure adequate moisture and nutrients. The end of the continuum is the sinks or dry lakes. Here, soil salinity is so high that few, if any plants can survive.

Overall, perennial plants on the desert slope are of three types: phreatophytes, xerophytes, and halophytes. Phreatophytes are plants which have deep root systems that can tap directly into underground water for a constant supply. This type of plant is limited to the washes, streams, oasis, and rocky soils penetrable by tap roots. On the study area, pheatophytes are found in the upper to middle elevations where temperature, water, and soil conditions can accommodate them. Xerophytes are plants which do not tap into underground water but, instead, have special adaptations to drought conditions. These adaptations include ways of reducing transpiration, storing water and extensive surface root systems for maximum moisture recovery. These adaptations result in a slow growth rate and wide spacing. Xerophytes dominate the lower alluvial fans and desert valleys of the study area. Halophytes are plants able to tolerate high salt concentrations. They are found exclusively around the dry lakes where no other plants can survive.

The zonation of specific plant associations will be discussed later as will wildlife. The species composition and diversity of fauna correspond directly to the


pinyon·juniper or semi·desert chap.
joshua tree
desert wash
Pinus monophylla
Juniperus californica
Yucca whipplei
Eriogonum fasciculatum
Populus fremon
Acacia gr
9000
8000
7000
6000
5000
4000
3000
2000
decreasing density
decreasing precipitation
increasing alkalinity
increasing temperature
mountain face
alluvial fan


creosote scrub
salt bush
Yucca brevifolia
Yucca schidigera
Opuntia echinocarpa
Ambrosia dumosa
Fouqueria splendens
Larrea tridentata
Atriplex spp.
desert floor
alkali sink

diversity, density and productivity of plant associations. This relationship will be stressed later in discussing impacts of development.

RESOURCE INVENTORY

DRAINAGE

The major canyons which conduct mountain runoff to the desert washes are shown on the drainage map. Each is a major part of the watershed supplying the underground basin into which it flows. Exact annual flow amounts have not been monitored for any of them; however, some estimates of recharge to the aquifers have been made. These estimates are based on U.S. Geological Survey studies and rough calculations of total precipitation in each watershed. Overall, it is estimated that only 3.8% of water falling within a watershed reaches underground storage. The rest runs off to the sinks, evaporates, or is used by plants.

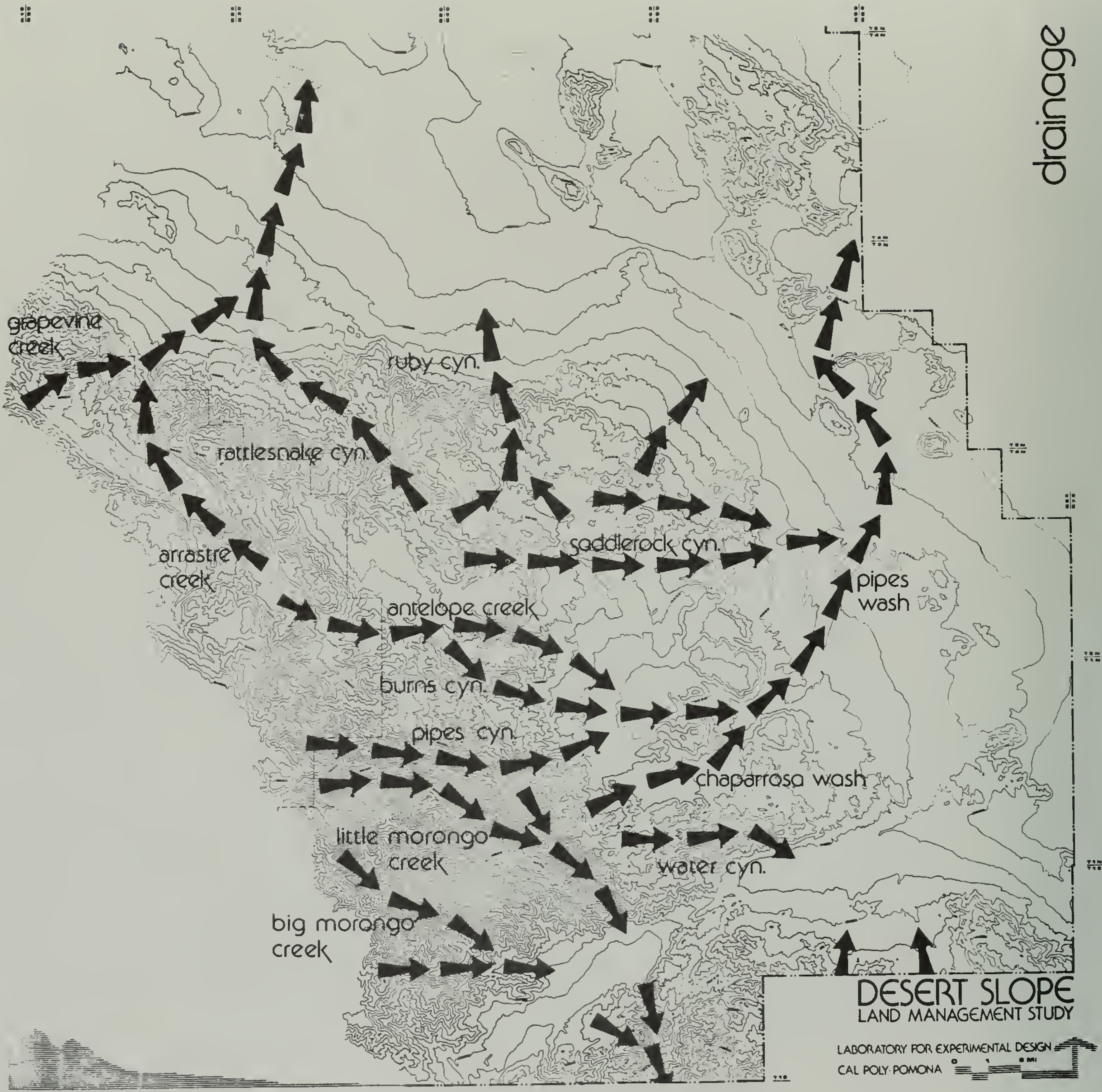
Careful watershed management is imperative to insure maximum water yield and prevent pollution of runoff. Such management should stress protection of vegetation and prevention of erosion. In addition, significant increases in water yield could be achieved with careful intervention in the natural runoff process. For example, impoundment of rapid runoff for slow release could augment the recharge of desert aquifers or provide a surface supply of water not now available. Such results would allow increased human use by utilizing water that would have been lost to evaporation or to the alkali sinks. However, careful consideration must be given to maintaining or augmenting natural recharge so that underground water is not depleted.

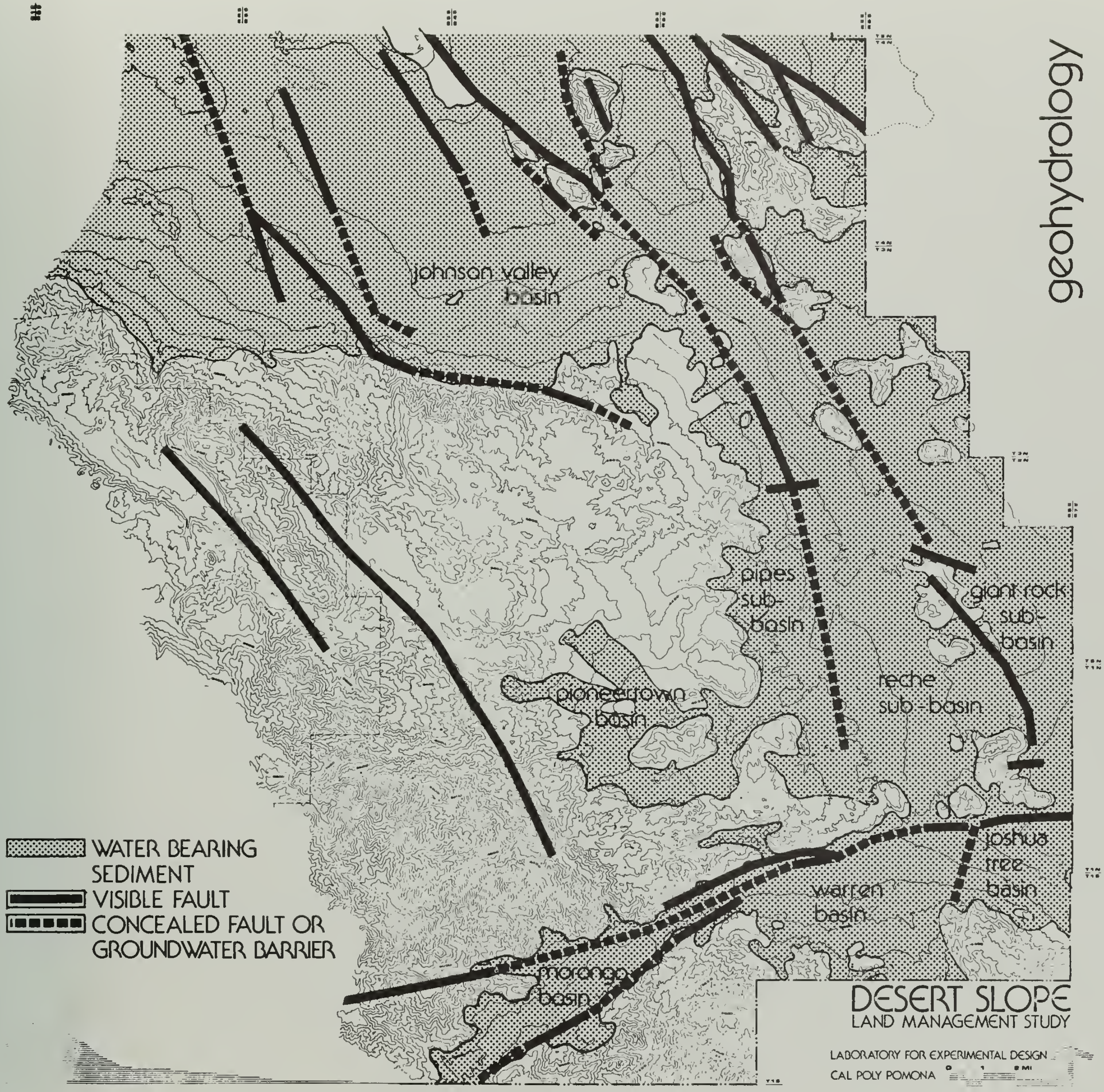
WATER BUDGET

BASIN	recoverable storage - 1000's of a.f.	quality	annual recharge - a.f.	annual pumpage - a.f.	annual surplus - a.f.	annual deficit - acre feet
johnson valley	125	●	581	0	581	—
pioneertown	ukn	○	ukn	25	ukn	—
pipes	120	○	500	60	440	—
reche	240	◐	⇩	75	—	ukn
giant rock	180	◐	⇩	0	0	—
joshua tree	144	○	200	360	—	160
warren	96	○	283	680	—	397
morongo	120	◐	275	ukn	—	ukn

○ - GOOD
◐ - FAIR
● - POOR

drainage


grapevine creek
ruby cyn.
rattlesnake cyn.
arrastre creek
saddlerock cyn.
pipes wash
antelope creek
burns cyn.
pipes cyn.
chaparrosa wash
little morongo creek
water cyn.
big morongo creek
DESERT SLOPE
LAND MANAGEMENT STUDY
LABORATORY FOR EXPERIMENTAL DESIGN
CAL POLY·POMONA


geohydrology
johnson valley basin
pipes sub-basin
giant rock sub-basin
reche sub-basin
pioneertown basin
joshua tree basin
warren basin
morongo basin
WATER BEARING SEDIMENT
VISIBLE FAULT
CONCEALED FAULT OR GROUNDWATER BARRIER
DESERT SLOPE
LAND MANAGEMENT STUDY
LABORATORY FOR EXPERIMENTAL DESIGN
CAL POLY POMONA
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GEOHYDROLOGY

The underground storage basins present in the study area are shown on the accompanying map. Water quality is important because, although a basin may contain large amounts of water, consumption and use by people may be prohibited. As water infiltrates into a basin, travels through it and migrates to other basins, it picks up increasing concentrations of soluble minerals. Extremes in dissolved mineral content are characteristic of the waters near dry lakes. Distinct maximum allowable concentrations have been established for human use. Without advanced treatment, some of the water stored underground in the study region is not suitable for use.

Where the water is potable, care must be taken to protect the resource. It has taken thousands of years to accumulate. In no case is natural recharge sufficient to replace large withdrawals, as evidenced by the Warren Basin underlying Yucca Valley. Once withdrawal rates exceed recharge, the resource must be considered non-renewable.

Storage and flow characteristics of the major ground water basins of the program area are summarized on the chart accompanying the map. As can be seen on this chart only Pipes Basin has both a significant annual water surplus and a potable level of quality. Joshua Tree and Warren Basins are being depleted by excessive pumping, and Giant Rock has approximately equal inflows and outflows.

Such examples as the Warren, Joshua Tree and Morongo Valley Basins illustrate the results of development occurring without sufficient knowledge or consideration for natural carrying capacities. In all three cases, points will be reached where imported water will be necessary unless attempts are made to limit water use. Few, if any, recycling or conservation efforts have occurred which might bring water use more in line with natural recharge. Future development should incorporate sound water management technologies so that maximum use can occur within the limits of the natural system.

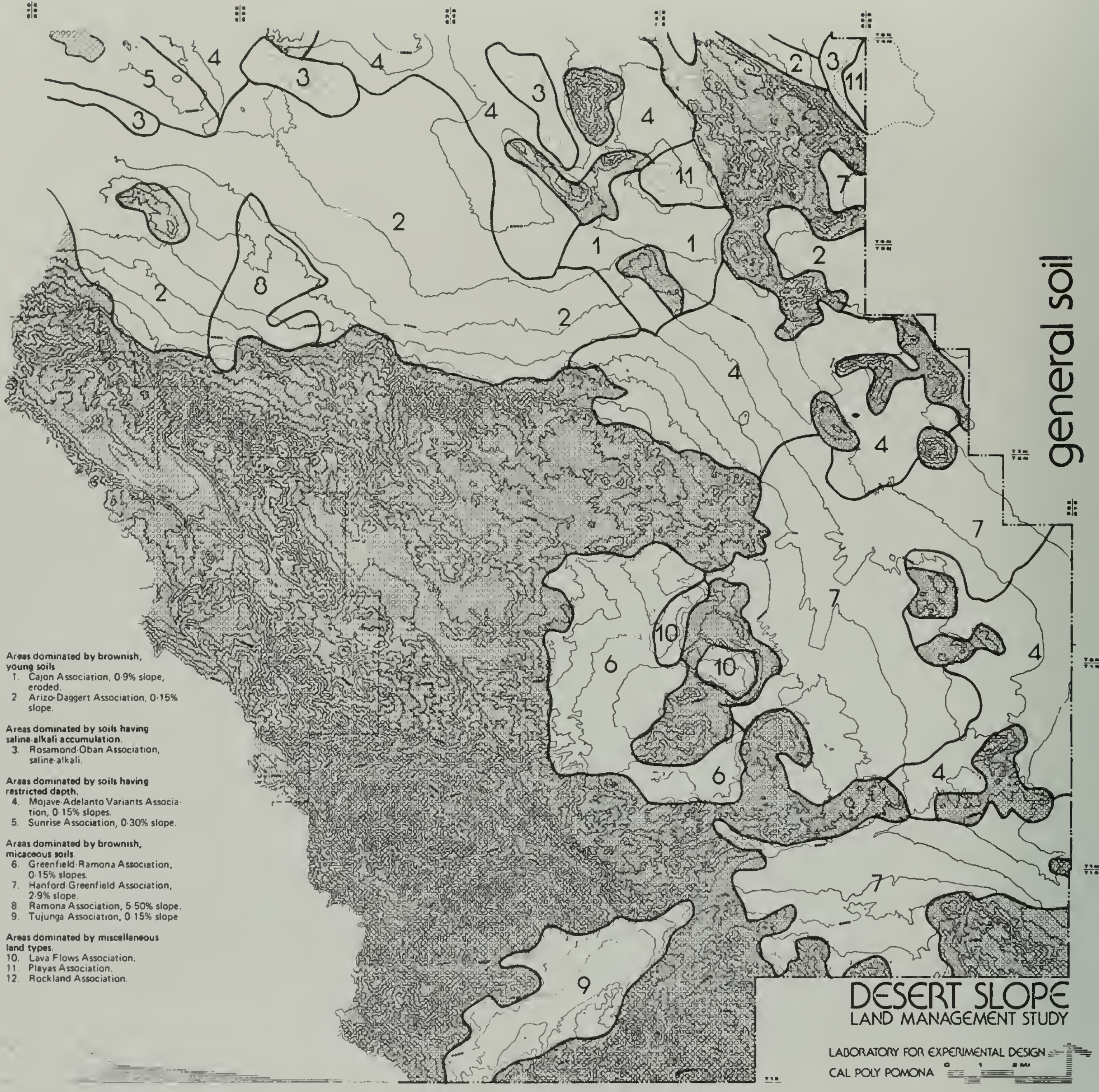
SOIL

The soils present on the Desert Slope Study Area offer a number of potentials and constraints for development. The information contained herein provides a general description of soil characteristics and qualities, as well as interpretive groupings, at a level useful only for planning at the regional scale. The data presented here is derived from a general soil reconnaissance conducted by the Soil Conservation Service in 1970. It is useful in mapping the hydrologic characteristics and agricultural potential of the soils of the study area. However, it is not specific enough to determine suitability for development of particular areas of land. More detailed study would be necessary before the soil's capacity to accommodate structures, roads, etc., could be determined. Once general suitability for development has been established, specific soil investigations should be carried out to aid in the development of a specific site plan.

LAND CAPABILITY CLASSES

The land capability classification is a national system which interprets various soil characteristics to determine suitability for sustained production of commonly cultivated crops and pasture plants. The classifications are based on such factors as fertility, texture, depth, salinity, and erosion potential.

general soil



Areas dominated by brownish, young soils
1. Cajon Association, 0·9% slope, eroded.
2. Arizo-Daggert Association, 0·15% slope.

Areas dominated by soils having saline-alkali accumulation.
3. Rosamond-Oban Association, saline-alkali.

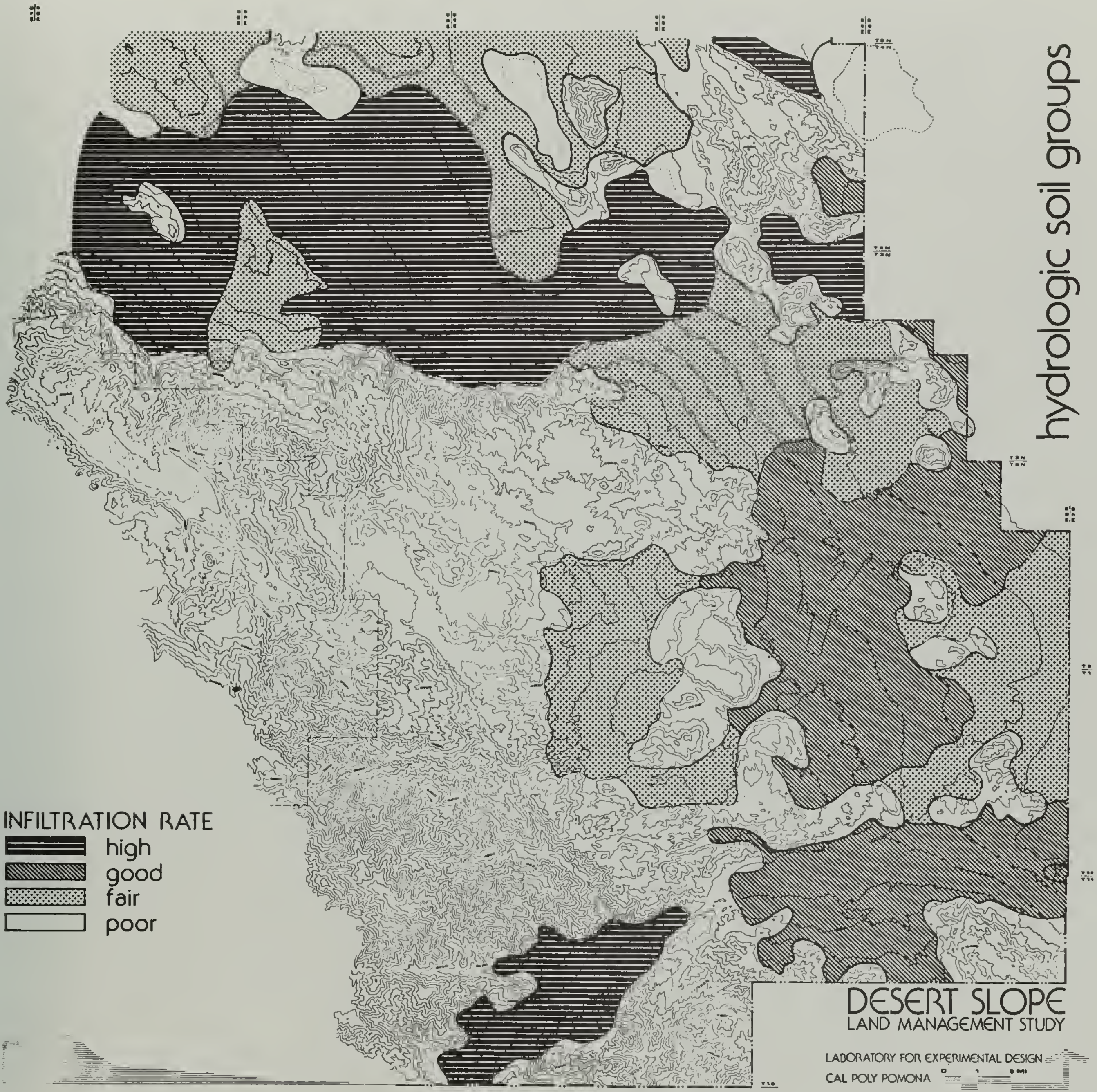
Areas dominated by soils having restricted depth.
4. Mojave-Adelanto Variants Association, 0·15% slopes.
5. Sunrise Association, 0·30% slope.

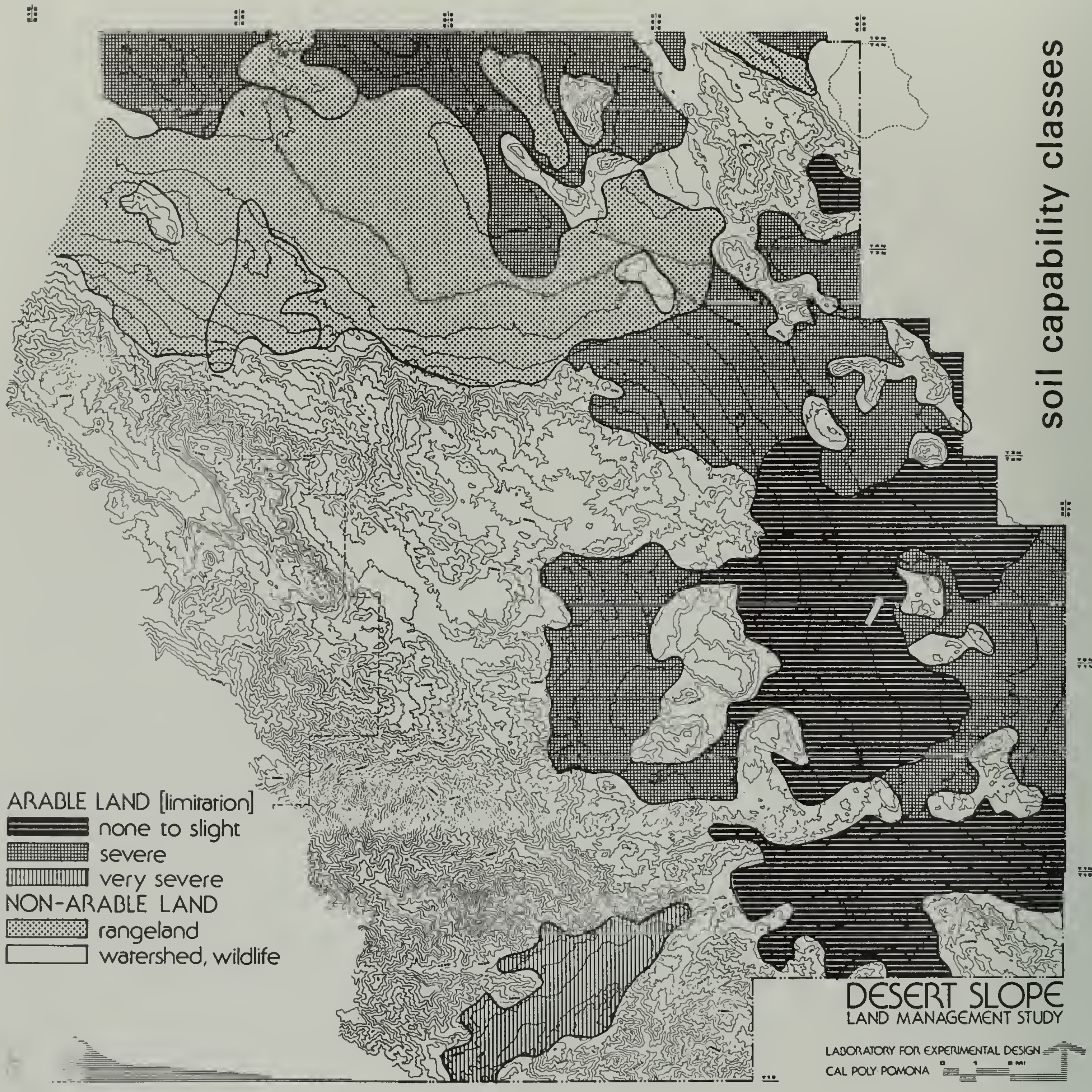
Areas dominated by brownish, micaceous soils.
6. Greenfield-Ramona Association, 0·15% slopes.
7. Hanford-Greenfield Association, 2·9% slope.
8. Ramona Association, 5·50% slope.
9. Tujunga Association, 0·15% slope

Areas dominated by miscellaneous land types.
10. Lava Flows Association.
11. Playas Association.
12. Rockland Association.

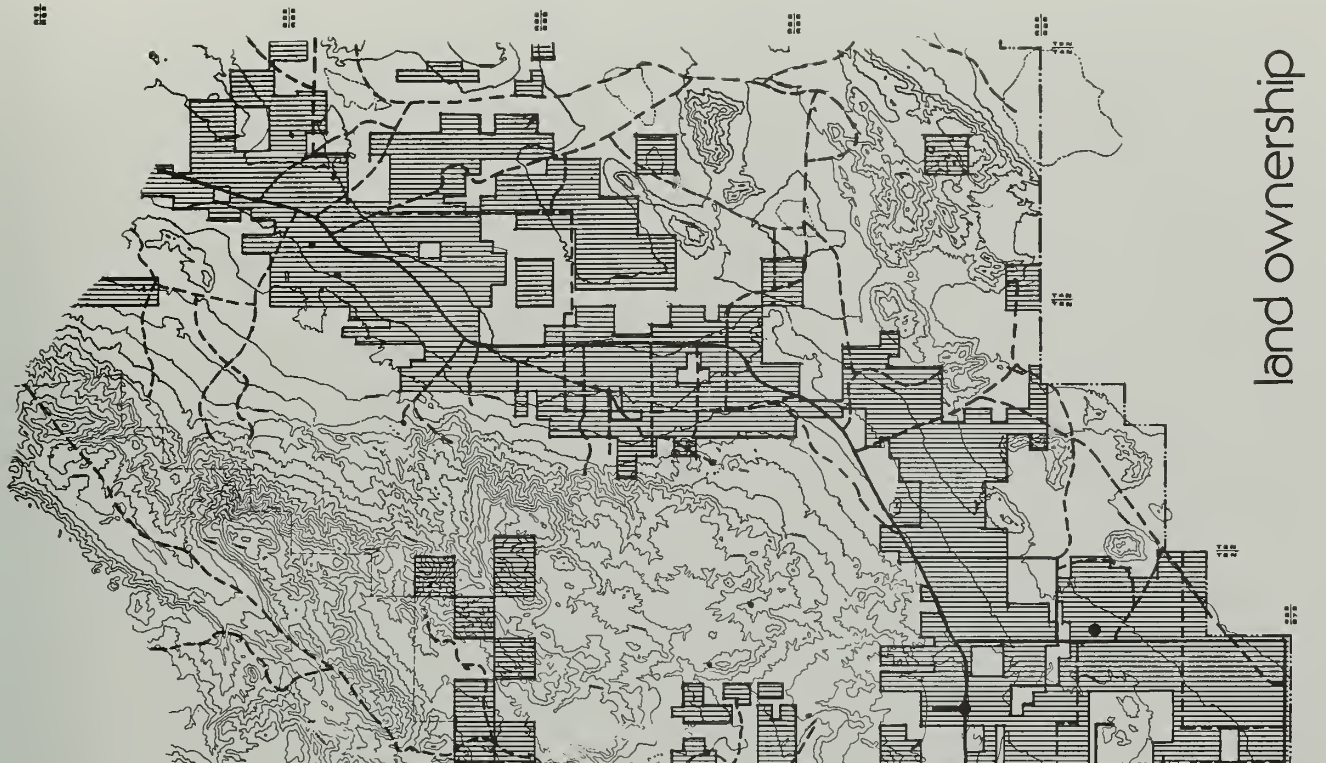
DESERT SLOPE
LAND MANAGEMENT STUDY

LABORATORY FOR EXPERIMENTAL DESIGN
CAL POLY POMONA


hydrologic soil groups
INFILTRATION RATE
▤ high
▨ good
░ fair
☐ poor
DESERT SLOPE
LAND MANAGEMENT STUDY
LABORATORY FOR EXPERIMENTAL DESIGN
CAL POLY POMONA
0 1 2 MI



soil capability classes


land ownership
PRIVATE
PUBLIC
DESERT SLOPE
LAND MANAGEMENT STUDY
LABORATORY FOR EXPERIMENTAL DESIGN
CAL POLY·POMONA

Regarding the soils of this study area, certain inherent constraints apply to all levels of suitability. Because of inadequate rainfall, no soil within the study area will be suitable for cultivation unless it can be irrigated. In areas with between 4 and 7 inches of annual rainfall, a limited sustained yield of native forage for livestock grazing can be expected without supplemental water. In areas with less than 4 inches, no sustained forage yield can be expected unless supplemental water is provided by runoff spreading or other means.

Other factors which must be considered in any cultivation within the study area include the ever-present potential for wind erosion (especially on sandy soils) and the need for careful management to sustain soil productivity. The latter consideration is important because fertility levels are poor, at best. Unless desert adapted, soil building types of agriculture are used (e.g. microcatchment and keyline), importation of fertilizers and soil amendments will be necessary. Introduction of such substances raises the potential for soil alkalinity and water quality problems.

HYDROLOGIC SOIL GROUPS

This classification of soils is useful in determining runoff potential in watersheds and the capacity of soils to infiltrate runoff. Such information has implications for any actions toward water harvesting for recharge to the underground basins, similar recharge operations for reclaimed water, or storage of imported water.

Soils with a high infiltration rate are those which are deep, consisting mainly of sands and gravels. Even when thoroughly wetted, these soils have a very high rate of water transmission. Obviously, then, these soils are the most suitable for use in recharge operations. Therefore, activities which disrupt this potential (e.g. extensive structural development, surfacing) should be kept to a minimum so that they can be utilized whenever necessary for recharge of water.

Soils with good infiltration rates are those having moderately course textures. They are still valuable as recharge soils. Soils in this classification, along with those in the first, have little problem in leaching soluble salts from the surface. With regard to agriculture, the potential for salt buildup in the soil is low but the potential for pollution of underground waters, via leaching of fertilizers and other materials, is high.

The fair and poor infiltration soils are not valuable for recharge. While some may be suitable for agriculture or devlopment, the danger of salt buildup from evaporation of applied water and deposition of nutrients from fertilizers is high.

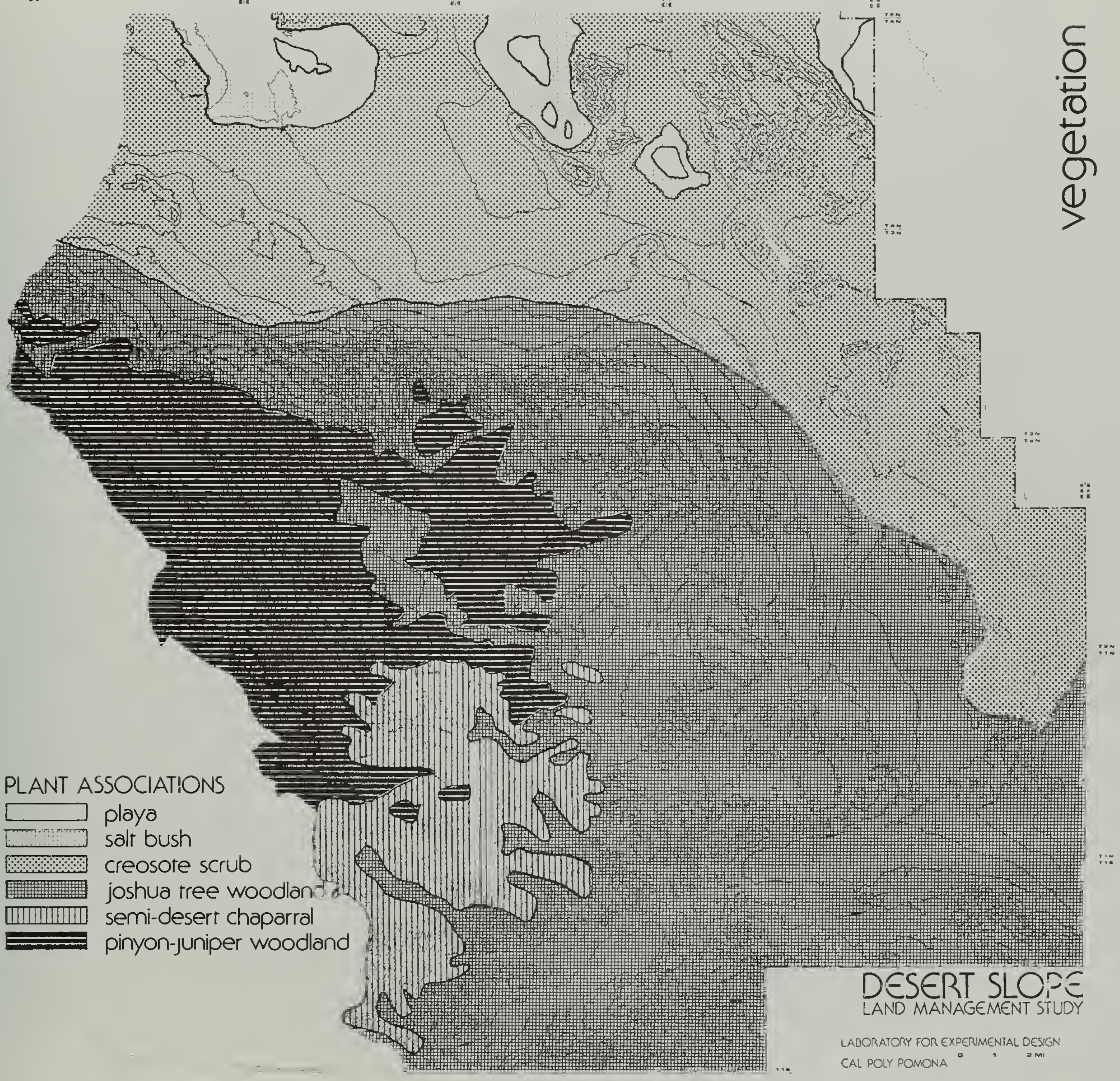
PLANT COMMUNITIES

In view of the environmental factors discussed in the ecosystem modelling section, plant response to the varying temperature, moisture, and soil conditions is based primarily on elevation and topography. The transect included here points out these relationships in reference to the specific plant associations found in the Desert Slope Study Area. The vegetation map illustrates the relative range of each association. The divisions between associations are not, of course, as distinct as indicated. Instead, each intermixes with the next in a transitional area known as the ecotone.

The major plant associations in the study area are: Pinyhon/Juniper Woodland, Semi-Desert Chaparral, Joshua Tree Woodland, Creosote Scrub, and Salt Bush. The important and relevant characteristics of these plant communities for purposes of use and development are discussed in Chapter B-II, and summarized in the chart that accompanies the map.

VALUE FOR:	PRESERVATION					DEVELOPMENT				
ASSOCIATION	animal habitat	watershed	productivity	recovery rate	summary value	slope gradient	height (screening)	density (screening)	resiliency	summary value
pinyon-juniper woodland	●	●	●	●	●	○	●	●	●	◑
semi-desert chaparral	●	●	◑	●	●	○	◑	◑	●	○
joshua tree woodland	◑	◑	◑	○	◑	●	●	◑	◑	●
creosote scrub	○	○	○	○	○	●	○	○	○	○
salt bush	○	○	○	○	○	●	○	○	○	○

● - HIGH
◑ - MOD.
○ - LOW


vegetation
PLANT ASSOCIATIONS
playa
salt bush
creosote scrub
joshua tree woodland
semi-desert chaparral
pinyon-juniper woodland
DESERT SLOPE
LAND MANAGEMENT STUDY
LABORATORY FOR EXPERIMENTAL DESIGN
CAL POLY POMONA
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TOPOGRAPHY

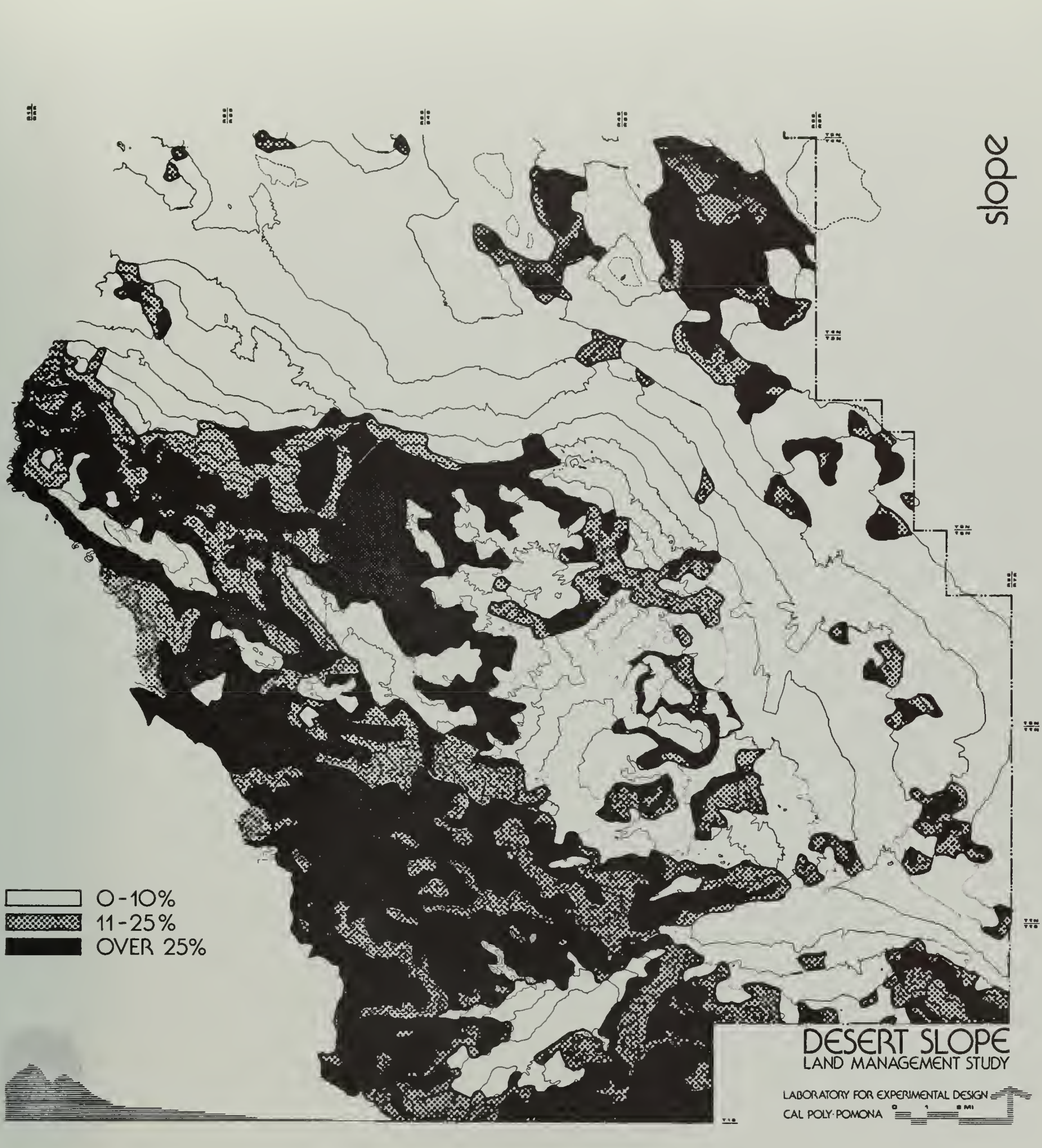
As shown on the map, elevations from within the Desert Slope program area range from less than 3000 to over 8000 feet. This extreme range includes a variety of topographic conditions. In general the highest slopes are steep and rocky, while the desert floor is flat and featureless. In between are many different conditions, including some dramatic rock formations and several serene valleys.

The slope map indicates that roughly one fifth of the area feature slopes of over 25 percent. These areas present serious difficulties for development in terms of costs, potential instability and erosion. Any construction undertaken here should be designed to deal with these problems. Building roads on these slopes will be especially difficult, and will almost certainly cause serious erosion.

VISUAL QUALITY

1 The Desert Slope Study Area contains a rich variety of striking visual contrasts. As a resource, the importance of scenic quality cannot be overemphasizd. Much of the value of the study area in attracting people for recreational and settlement rests in its visual character. The scenic experiences range from long vistas to fascinating rock formations better viewed up close. When development of any kind is proposed, preservation of visual quality must be a high priority.

In analyzing the study area's capacity to absorb visual intrusions of surface development and use, these factors are important: height and density of vegetation, long views, short views, landform, and focal points.

slope
0-10%
11-25%
OVER 25%
DESERT SLOPE
LAND MANAGEMENT STUDY
LABORATORY FOR EXPERIMENTAL DESIGN
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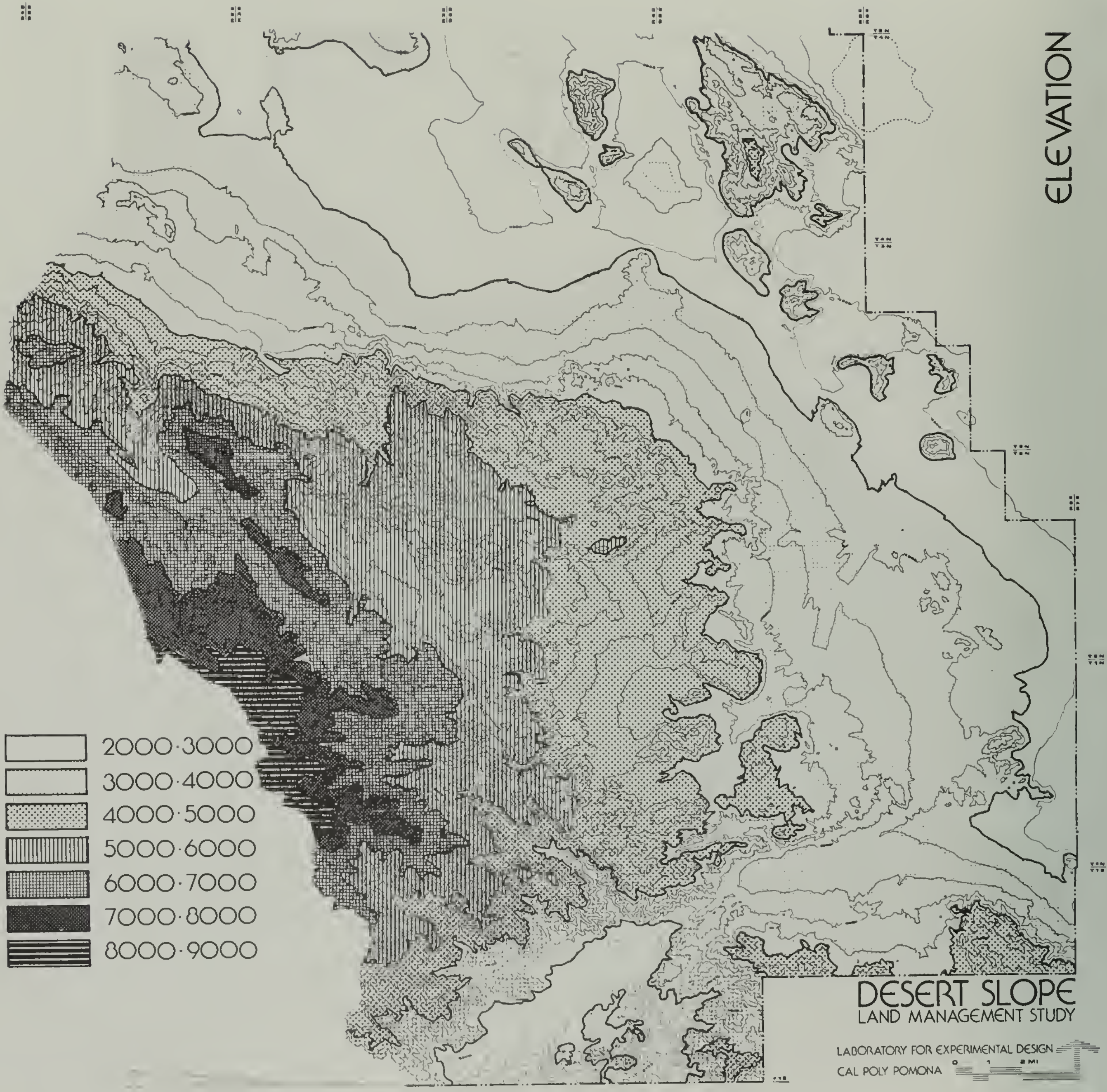
ELEVATION


2000·3000
3000·4000
4000·5000
5000·6000
6000·7000
7000·8000
8000·9000
DESERT SLOPE
LAND MANAGEMENT STUDY
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HEIGHT AND DENSITY OF VEGETATION

This factor, as mentioned in the vegetation section, is important for mitigating the impact of development. In areas where the natural vegetation is high and dense (e.g. the Joshua Tree or Pinyon Associations), structures and activities can more easily be placed without serious impairment of visual quality. On the other hand, activities placed in the low, open Creosote Association can be visible for miles, interrupting fine vistas. This factor indicates that development should not occur in areas with low and open vegetation within the range of a long, interesting view. This general premise must be tempered by information regarding the composition of the view being considered.

LONG VIEWS

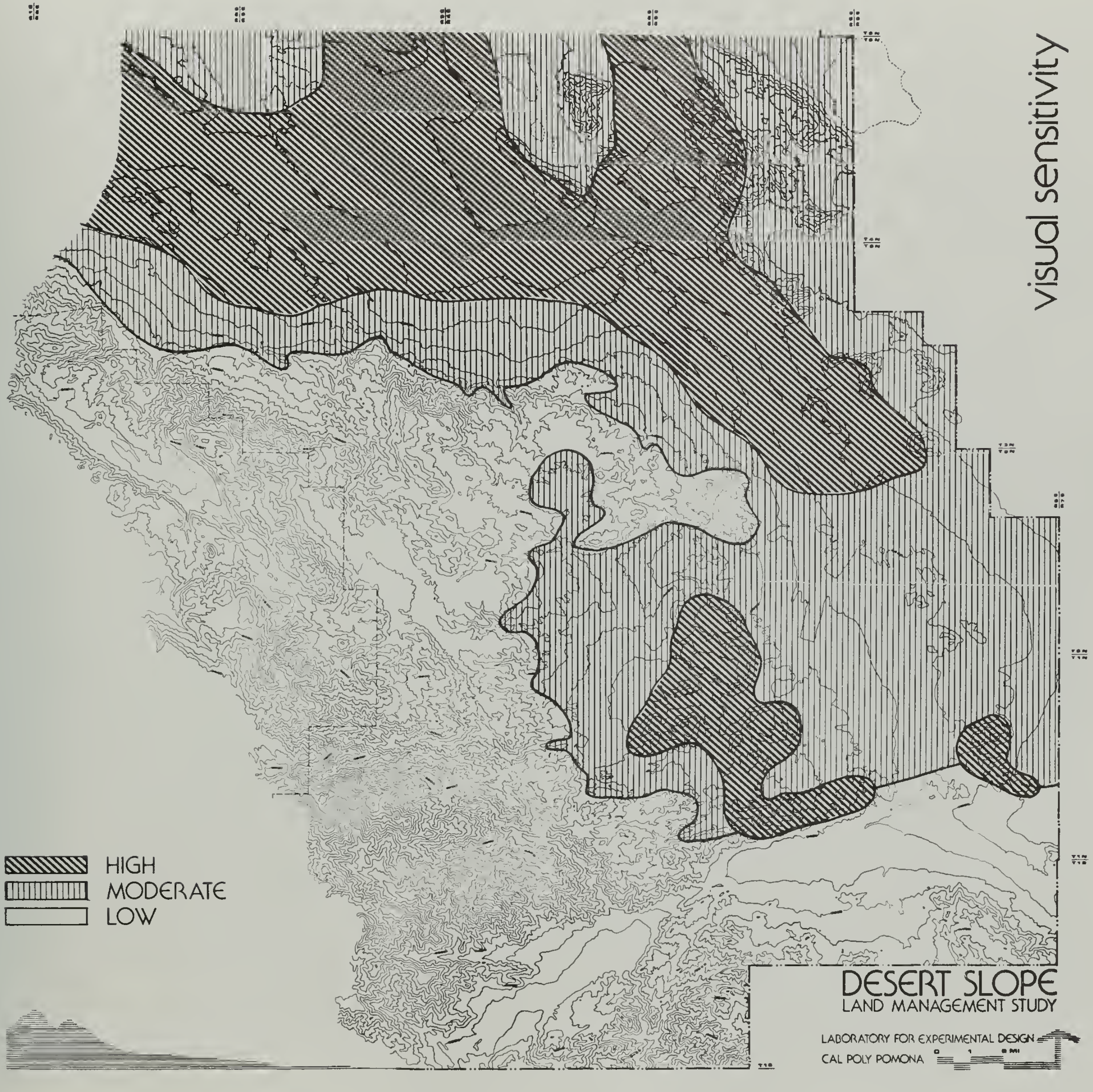
Many scenic vistas characterize the study area. They can be categorized as follows: 1. those which look from higher ground out over broad valleys, possibly to focal topography in the distance, and 2. those which look from the valleys toward the imposing San Bernardino Mountains. These two types of long view have different implications for development. Those which look out over broad valleys are easily disturbed by structures, roads, etc. This is easily evident by a drive through the study area. The effect is amplified because the Creosote Association, which occupies much of the valley floor, and which offers no relief. The major examples of this effect are in Johnson Valley and northern Means Valley where scattered settlement can be seen from miles away.

The second type of view lends itself more readily to placement of development. The view is composed of the valley floor as foreground, the foothills as middle and the distant mountains as background. Often the mountains are so imposing in contrast to the flatness of the valley that development on the foothills does not have too significant an effect on the overall impression. This principle can also have implications on the vistas across the broad valleys. While development is highly intrusive on the valley floors, placement at the base or behind topographic features in the distance can preserve the vista while accommodating use. If these general principles are considered in locating development, the long views characteristic of the northern parts of the study area can be preserved for both the visitor and resident.

SHORT VIEWS

The topography of the study area creates many areas where the primary views are of short distance. In these cases, the details present in the visual range become more important. For example, the rock outcropping, landform, or vegetation can be the primary source of visual interest. In such cases, development must be sensitive to preserving these values. Structural forms and materials should reinforce the rock character; removal of interesting vegetation should be avoided (e.g. Joshua Tree or cactus); and building on ridgelines should be prohibited to preserve the character of the landform. While these considerations apply more to the actual placement of development, they illustrate principles which should guide all use and building so that visual quality values can be preserved within developed areas.

visual sensitivity



LANDFORM

Landform characteristics can have strong influence on an area's ability to absorb development and still maintain visual quality. Broad, flat valleys have little or no capacity to absorb intrusion due to lack of topographic interest and vegetative screening while areas with rolling terrain have a high capacity to absorb development. This is especially true when considering the driving or hiking experience. Settlement can be placed on slopes facing away from roads and trails. This strategy preserves the visitor's experience while allowing development. Placing structures on only one side of a small valley will preserve the resident's view across to the opposite slope. This is a consideration applicable to more detailed site planning.

FOCAL POINTS

There are many examples of striking landforms or rock formations throughout the study area. Some examples are Flat-top Mountain with its associated Lava Buttes and the wind sculpted rock formations along the road from Yucca Valley to Pioneertown. Such features are sources of excellent scenic experiences and should remain in their natural state for all to enjoy. Some are visible from paved highways and are available to the passing sightseer while others are only accessible to hikers or off-road vehicle (O.R.V.) riders. Regardless, freedom from development for such choice sites should be insured.

VISUAL SENSITIVITY

Using the analysis from the previous sections, a rating of sensitivity to developmental intrusions has been developed. Areas rated highly sensitive are characterized as vital focal areas or important components of long views with no vegetative or topographic relief. Development should either be prohibited or take unobtrusive forms (e.g. underground structures). Areas rated moderately sensitive have benefit of good vegetative cover and/or good landform characteristics. Nonetheless, development should be sensitively based on principles illustrated in the short view and landform sections. The low sensitivity rating applies to mountain areas where topography and vegetation easily absorb visual intrusions to areas isolated from important visual corridors and to those areas already irrevocably given over to development.

When combined with the analyses of soil, vegetation, and hydrologic values, this information will be valuable in locating areas suitable for development. An overlay system will be used in the determination of suitability areas.

SUITABILITY MAPPING

RECREATION

Recreation in the study area takes many forms, each with its particular impacts and locational criteria. These various forms can be grouped into three categories: passive, developed, and O.R.V. Such categorization forms the basis of land suitability mapping for recreation.

PASSIVE

This category of recreational use includes activities which are compatible with the goals of preservation.

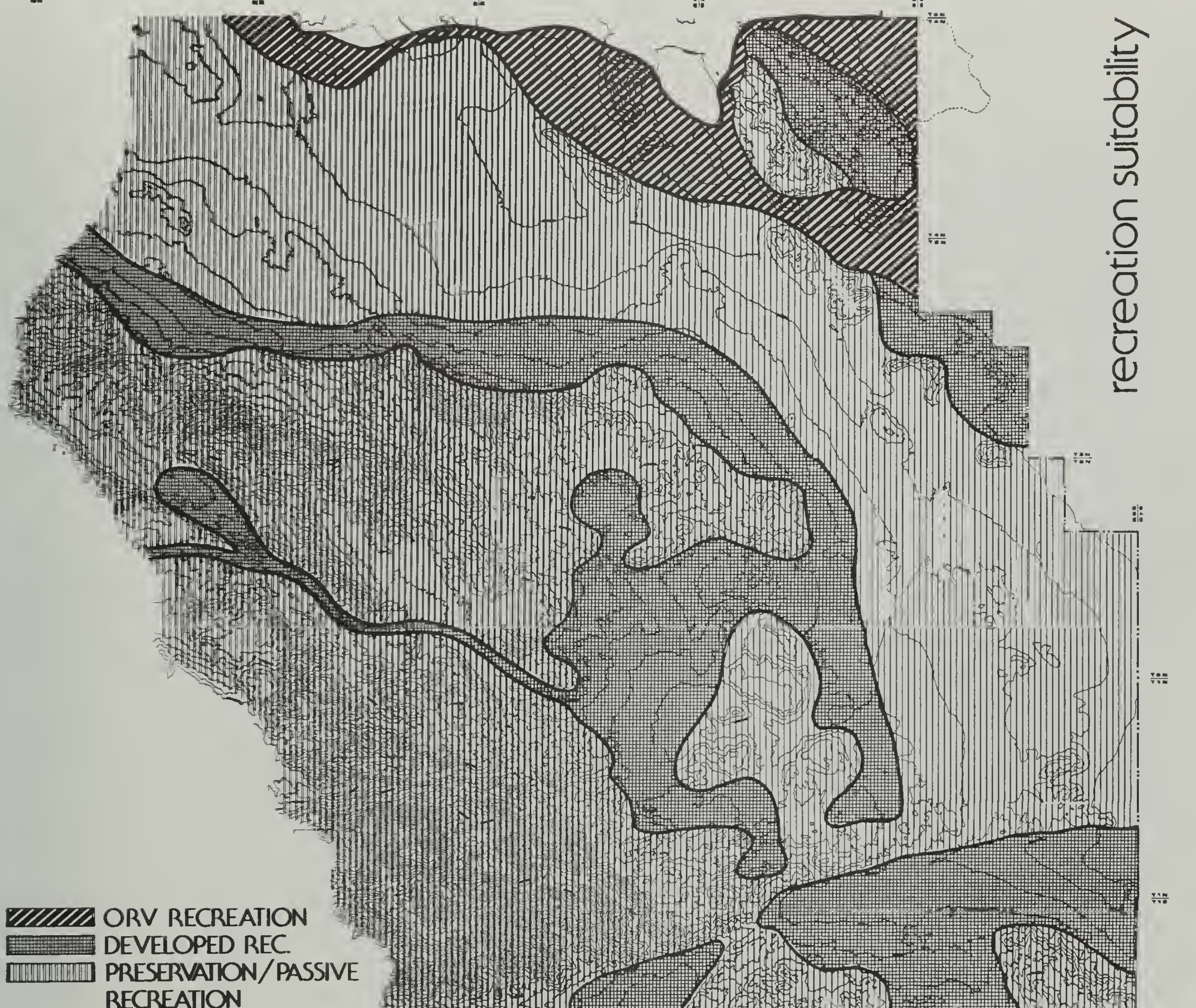
Areas of important watershed, wildlife or scenic values can be enjoyed in ways which have minimal environmental impact. The forms of use included in this category are nature study, and primitive, secondary primitive, intermediate, and secondary modern camping. A use which can also be compatible with these areas is hunting because only in the highly diverse habitats of the preserved zones are there sufficient numbers of wildlife species to support it. However, strict controls must be placed on this activity.

Management for this recreation category is primarily a matter of visitor control. If necessary, similar systems to those of the Forest Service and National Parks can be instituted to provide for visitor registration, definite capacities for campgrounds, fire permits, and limits on user numbers in wilderness areas.

In order to allow such control so that adequate protection of environmental values can be assured, all lands in this category should be in public domain. A ranger force, as provided for in the Federal Land Policy and Management Act, should be formed to provide information, safety, and control services.

With such a capacity for monitoring use, maximum public enjoyment of these lands can be achieved commensurate with maintenance of environmental quality. A specific area of concern will be the controls placed on hunting. Specific times, locations, and numbers of kills should be established to insure that this use not intefer with other, passive uses and not deplete any wildlife resource.

In order to arrive at specific locations for campgrounds, hiking trails, hunting areas, etc., a detailed recreation plan should be prepared based on the priorities of preservation.


recreation suitability
ORV RECREATION
DEVELOPED REC.
PRESERVATION/PASSIVE RECREATION
DESERT SLOPE
LAND MANAGEMENT STUDY
LABORATORY FOR EXPERIMENTAL DESIGN
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DEVELOPED

Included in this category are activities which require extensive support facilities or involve intensive environmental modification. Recreational uses of this type are resort development, modern campgrounds, flying, shooting, and concentrated group activities.

Such use should not be placed within areas of high environmental value. Often, modern camping, concentrated group recreation, and resorts can be near preservation zones to take advantage of desirable settings or access to natural areas. Actual location in a significant watershed, wildlife habitat, or view corridor should be avoided due to the high potential for degration.

Shooting is included in this category because it must be specifically located and controlled to avoid disruption of other uses and danger to other visitors. Firearms should be limited to ranges.

Concentrated group recreation frequently applies to gatherings of users for a specific purpose. Examples of this are the annual UFO conference and various O.R.V. events. Developed support facilities for such activities should be located near the site of the event so that sufficient accommodation and control of visitors can be achieved. The northeastern area specified on the map for developed recreation answers such needs.

While management directions are to some extent inherent in locational criteria, actual administration and control methods must be delineated. Most intensive uses included in this category would best be administered by private enterprise with proper controls by the BLM. Resorts, R.V. campgrounds, shooting ranges, airports, etc., are all possible as private ventures. The site planning and design guidelines given in Part C will provide direction for specific planning. In response to a firm development plan, the BLM should evaluate the need, desirability, and proposed locational setting for any recreation development and determine what controls are appropriate to insure integration with other uses and land suitabilities. In this way, the BLM can avoid the economic and visitor management problems associated with developed recreation while maintaining necessary control.

OFF ROAD VEHICLES

This category of recreation is the most intensive and potentially disruptive. As stated in the locational criteria, O.R.V.'s must be placed away from any important watershed, wildlife, soil, or scenic value because of the impact they have on these resources.

The BLM has designated an authorized O.R.V. area in the same location as shown on the map. While disruption of the local environment in that area is inevitable, the resource values present there are the lowest in the study area. If O.R.V. use can be limited to this dry lake zone, conflicts with other uses or environmental values can be minimized.

The major management problem, however, is how to limit O.R.V. use to a specified area. The only reasonable solution rests in enforcement capabilities. Without enforcement personnel, the present pattern of O.R.V. use in authorized areas will continue. In order to achieve proper control with the proposed ranger force, all O.R.V. lands should be maintained in public domain so that future flexibility is insured.

SETTLEMENT

Along with the priority criteria of not locating development in areas of high vegetative, wildlife, watershed or hydrologic values, the major factors used in determining suitability for settlement are: slope, vegetation, water, soil and visual quality. Most forms of settlement have similar locational criteria in reference to the first three of these factors. However, when soil and visual quality are considered, a distinction is seen between forms of development which have a high visual impact and those with low visual impact.

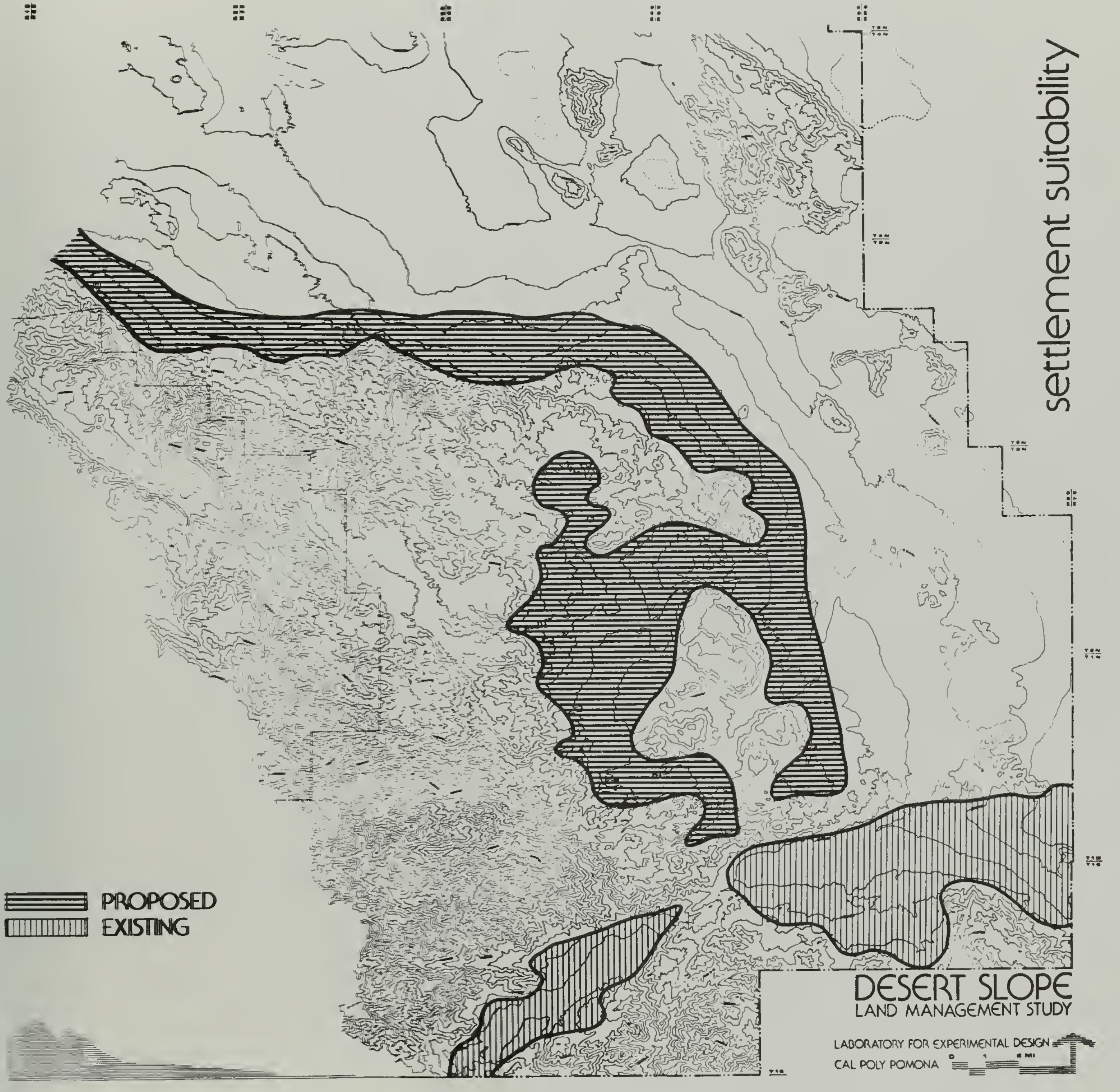
SLOPE

A maximum gradient of 25% was used in determining settlement suitability. At any slope above this, development costs become significantly higher, utility service becomes more difficult, and erosion potential is a serious factor.

VEGETATION

Ideally, development will occur only where native vegetation is resilient enough to co-exist with adjacent structural forms. The height and density of the flora should also be sufficient to allow some screening of surface structures. Generally, the Joshua Tree Woodland is the most suitable in these regards. If any development occurs in the more open areas, like the Creosote Scrub, subsurface or semi-subsurface forms should be used.

settlement suitability



WATER

Probably the strongest locational factor governing settlement suitability mapping is the availability of water. From the ecosystematic analysis and inventory sections, we can expect that the best location for harvesting native water is in the foothills directly below the major watersheds. It is here that most recharge occurs and most runoff escapes. Water harvesting from these watersheds could directly supply an adjacent development. Development over an isolated and exhaustible aquifer is inadvisable. Most settlement should occur where water can be intercepted, used, reclaimed and sufficient natural recharge insured.

SOIL

This factor has its most obvious impact on subsurface development. Many soils in the study area have restricted depth. This limitation is important for determining what areas will allow unobtrusive, below grade building if other factors like vegetation or scenic quality indicate its desirability.

Other soil factors like bearing capacity and shrink-swell potential must be determined specifically before any development can occur. Existing information is inadequate for this purpose.

VISUAL QUALITY

Once suitability for settlement is establishd by applying the first four criteria, maintenance of visual quality must be the final goal. Referring to the development suitability map, two categories of visual impact have been established.

Those building forms which have high visual impact are to be located in the foothills where landform and vegetation can be used to mitigate their visual intrusion. Such surface structures as greenhouses of 2-3 story buildings must take advantage of these opportunities. Remembering, also, the visual quality analysis, surface development in the foothills is far less obtrusive due to the dramatic backdrop of the mountains.

Where vegetation and topography do not offer such benefits, unobtrusive structures should be utilized. The primary forms for use here are subsurface and semi-subsurface. Single level surface structures might be acceptable in a flat area where vegetation offers some relief.

AGRICULTURE

The four major categories of agricultural suitability are: 1. conventional cultivation or controlled environment; 2. controlled environment only; 3. runoff agriculture; and 4. limited grazing.

CONVENTIONAL OR CONTROLLED ENVIRONMENT

Within this category, soil and slope characteristics offer the potential for conventional cultivation only if irrigation water is available. Such water can only be expected in limited quantities under the native water budget. However, if imported sources were made available, more extensive cropping could occur. Controlled environment agriculture like the French-intensive/bio-dynamic method is also possible in this category. Such techniques offer superior yields with minimal irrigation and might form the basis for food or income in this enviornment. Such benefits when coupled with the comparatively small land requirement might warrant the use of some of the water budget.

CONTROLLED ENVIRONMENT

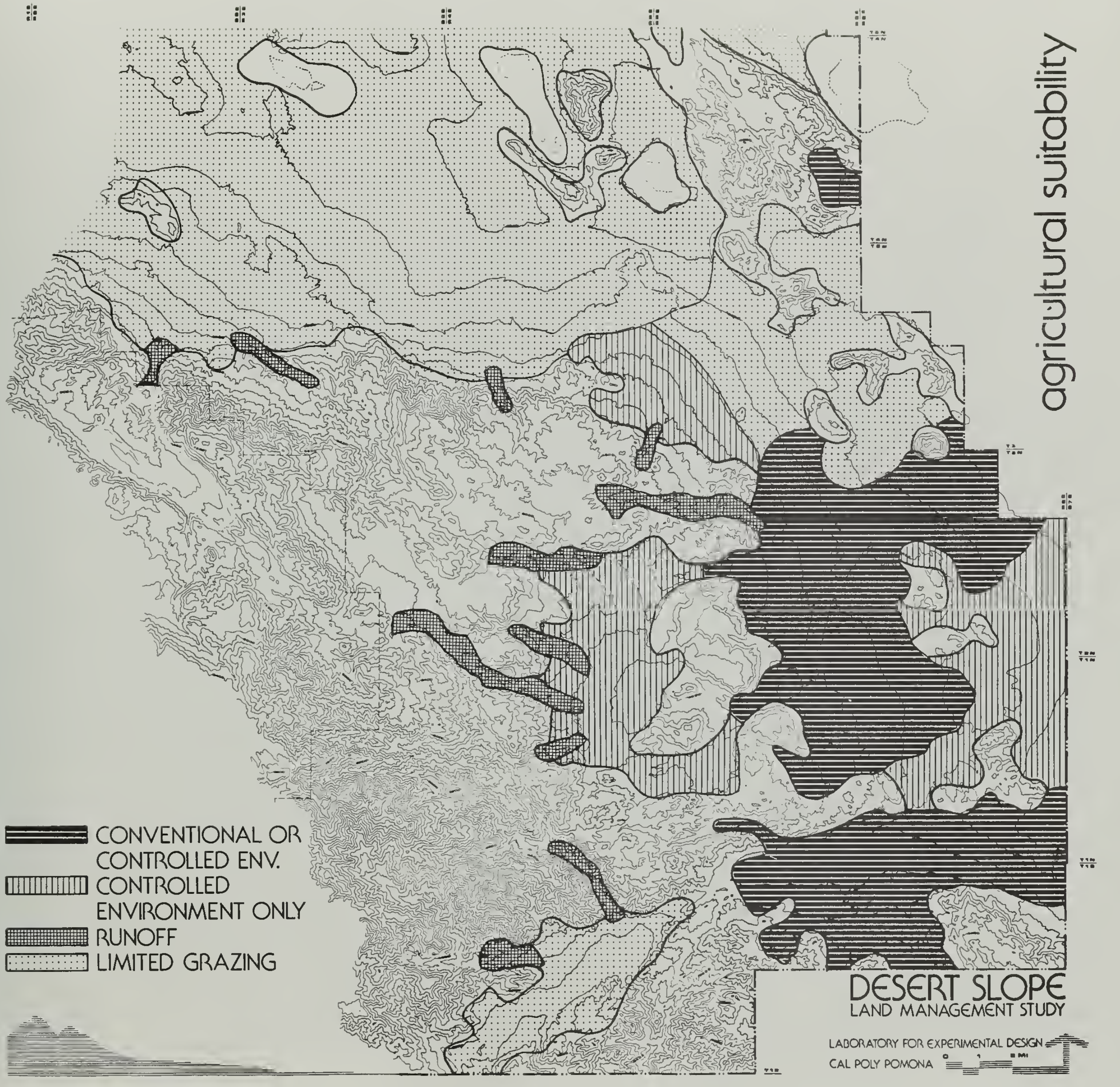
Since these types of agriculture require special soil manipulation techniques, areas not suitable for conventional cultivation might still be used for food production. In areas where this potential coincides with development suitability, a good integration of uses could be achieved. Production of food could be either at a household or community wide scale and the water source could be the reclaimed component of the settlement's water budget.

RUNOFF AGRICULTURE

Techniques like keyline and microcatchment require location near sources of surface runoff. This would require their placement in or near channels below the steeper sections of the watershed. Such types of agriculture are effective both as means of food production and water management and could also be well integrated with settlements.

LIMITED GRAZING

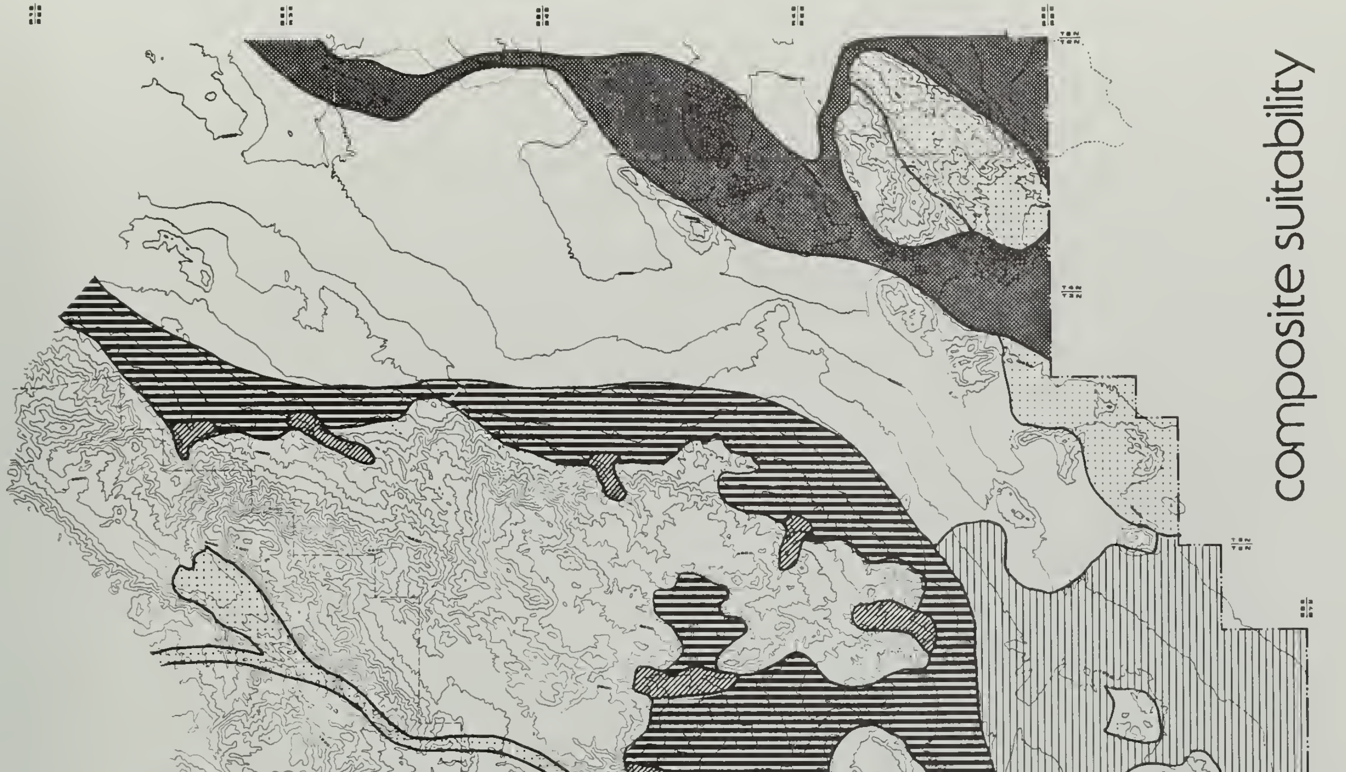
Historically, the study area was used for livestock production. The major critical requirement is prevention of over-grazing and destruction of natural vegetation. While the potential for sustained grazing is low, periodic, controlled use can occur.


agricultural suitability
CONVENTIONAL OR CONTROLLED ENV.
CONTROLLED ENVIRONMENT ONLY
RUNOFF
LIMITED GRAZING
DESERT SLOPE
LAND MANAGEMENT STUDY
LABORATORY FOR EXPERIMENTAL DESIGN
CAL POLY POMONA
0
1
2 MI

COMPOSITE SUITABILITY

This map illustrates the basic potentials for multiple use in the study area. As can easily be seen, much potential for integrated communities exists. Such settlements, which stress a high degree of self-sufficiency, should be encouraged. Of course, the actual extent to which these communities or any development can take place should depend on local water supplies and other site-specific factors.

It is important to recognize that the composite map should not be considered a plan. It only illustrates overall suitabilities based on environmental, social and political critical issues. However, from this composite map and general management guidelines mentioned for various uses, we can derive a more workable ownership pattern for the Desert Slope. By overlaying the composite suitability map on the existing pattern of ownership, we can readily see areas which could be leased or sold by the BLM for private use. Likewise, by looking at those areas which are recommended to be in public domain for management of resources, we can see those areas which should be reacquired by the BLM. These are illustrated on the map showing proposed ownership patterns.


composite suitability
MULTIPLE USE - (settlement, rec., and/or agriculture)
ORV RECREATION
DEVELOPED REC.
CONTROLLED ENVIRONMENT AGRI.
RUNOFF AGRICULTURE
DESERT SLOPE
LAND MANAGEMENT STUDY
LABORATORY FOR EXPERIMENTAL DESIGN
CAL POLY POMONA
0
1
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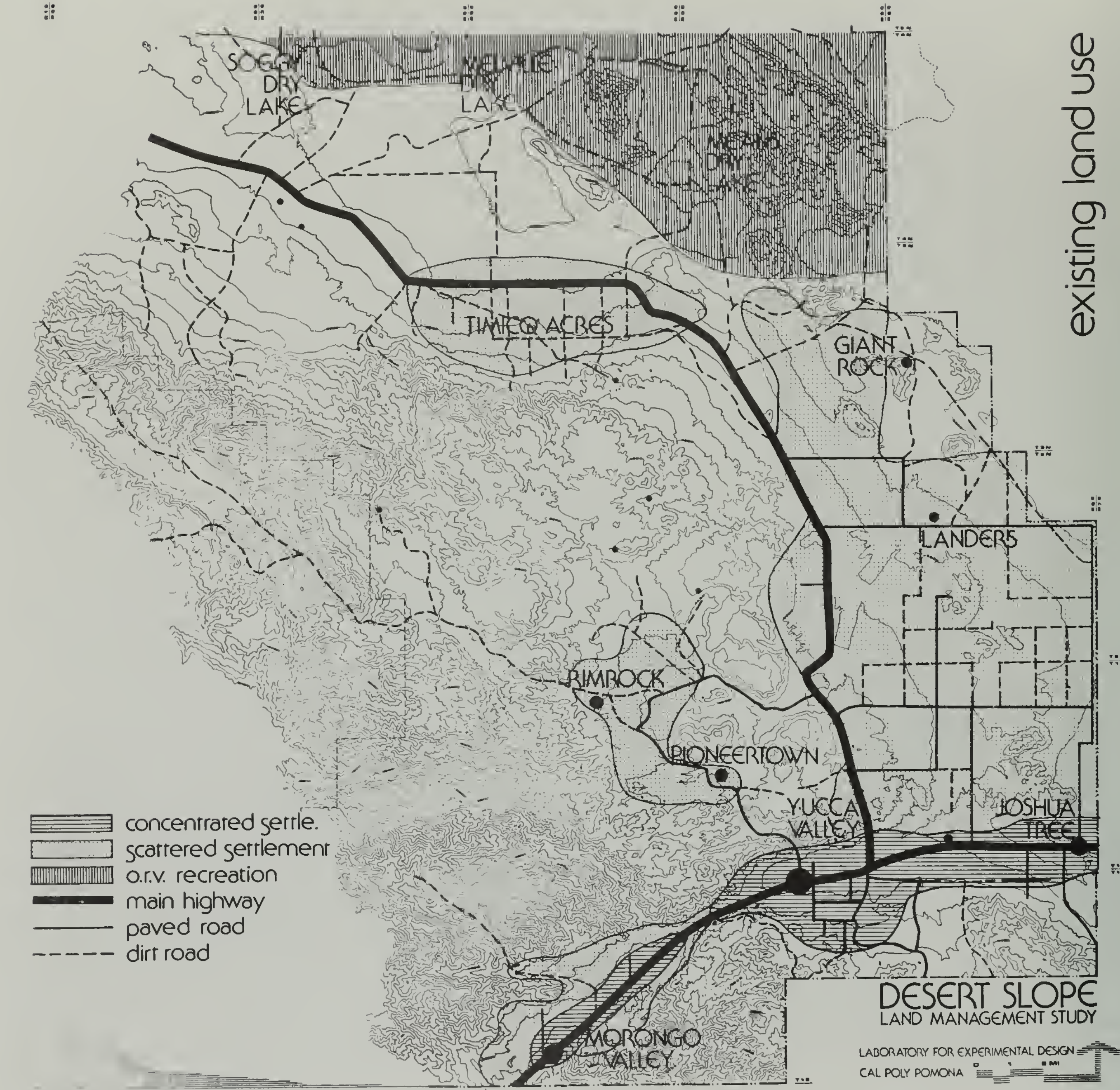
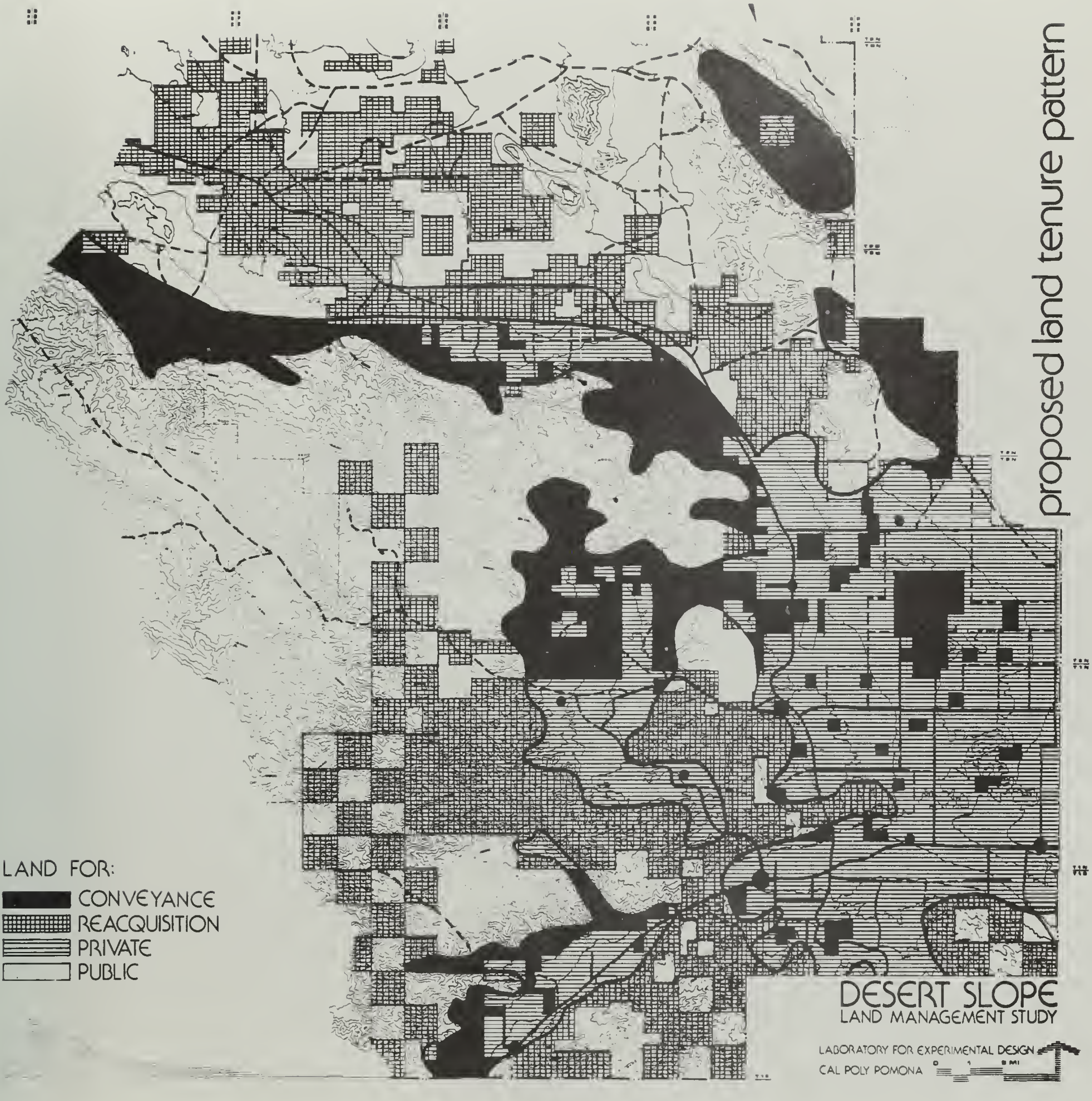
existing land use




proposed land tenure pattern
LAND FOR:
CONVEYANCE
REACQUISITION
PRIVATE
PUBLIC
DESERT SLOPE
LAND MANAGEMENT STUDY
LABORATORY FOR EXPERIMENTAL DESIGN
CAL POLY POMONA

APPENDIX

EXCERPTS FROM FLPMA

The following excerpts from the Federal Land Policy and Management Act of 1976 are included to provide detailed information that will be needed in formulating land use plans and tenure adjustment programs. Section 202 gives the requirements for land use planning. Sections 203 through 206 give criteria for sales, withdrawals, acquisitions and exchanges. Parts of Section 501, dealing with rights of way are also included.

IV **Land Use Planning** (FLPMA, Sec. 202)

A. **Policy**

Sec. 202. (a) The Secretary shall, with public involvement and consistent with the terms and conditions of this Act, develop, maintain, and, when appropriate, revise land use plans which provide by tracts or areas for the use of the public lands. Land use plans shall be developed for the public lands regardless of whether such lands previously have been classified, withdrawn, set aside, or otherwise designated for one or more uses.

(b) In the development and revision of land use plans, the Secretary of Agriculture shall coordinate land use plans for lands in the National Forest System with the land use planning and management programs of and for Indian tribes by, among other things, considering the policies of approved tribal land resource management programs.

(c) In the development and revision of land use plans, the secretary shall—

(1) use and observe the principles of multiple use and sustained yield set forth in this and other applicable law;

(2) use a systematic interdisciplinary approach to achieve integrated consideration of physical, biological, economic, and other sciences;

(3) give priority to the designation and protection of areas of critical environmental concern;

(4) rely, to the extent it is available, on the inventory of the public lands, their resources, and other values;

(5) consider present and potential uses of the public lands;

(6) consider the relative scarcity of the values involved and the availability of alternative means (including recycling) and sites for realization of those values;

(7) weigh long-term benefits to the public against short-term benefits;

(8) provide for compliance with applicable pollution control laws, including State and Federal air, water, noise, or other pollution standards or implementation plans; and

(9) to the extent consistent with the laws governing the administration of the public lands, coordinate the land use inventory, planning, and management activities of or for such lands with the land use planning and management programs of other Federal departments and agencies and of the States and local governments within which the lands are located, including, but not limited to, the statewide outdoor recreation plans developed under the Act of September 3, 1964 (78 Stat. 897), as amended, and of or for Indian tribes by, among other things, considering the policies of approved State and tribal land resource management programs.

V. Public Involvement

A. Policy

1. **FLPMA, Sec. 202 (f).**

   The Secretary shall allow an opportunity for public involvement and by regulation shall establish procedures, including public hearings where appropriate, to give Federal, State, and local governments and the public, adequate notice and opportunity to comment upon and participate in the formulation of plans and programs relating to the management of the public lands.

2. **E.O. 11514. Protection and Enhancement of Environmental Quality.**

2. **Sec. 2. Responsibilities of Federal agencies.**

   (b) Develop procedures to ensure the fullest practicable provisions of timely public information and understanding of Federal plans and programs with environmental impact in order to obtain the views of interested parties. These procedures shall include whenever appropriate, provision for public hearings, and shall provide the public with relevant information, including information on alternative courses of action. Federal agencies shall also encourage State and local agencies to adopt similar procedures for informing the public concerning their activities affecting the quality of the environment.

VI. Resource Programs

A. Lands

1. **Description of Program Activity.** The lands and realty program includes classifying and tenure adjusting to support Bureau and other agency needs; disposes of and leases public lands found suitable for the legitimate needs of the private sector; provides for recreation and public purpose uses; coordinates and grants rights-of-way to cross

public lands; mitigates and resolves unauthorized use and occupancy of public lands; coordinates land acquisitions through exchange and purchase; reviews and processes withdrawal actions both to restore and remove public lands from the operation of non-discretionary laws or acts; provides for the temporary use and occupancy of pubic lands by the private and governmental sectors; and maintains a land and title record system.

2. **Policy. FLPMA.**

a. **Declaration of Policy.**

Sec. 102(a) (1).

The public lands shall be retained in Federal ownership, unless as a result of the land use planning procedure provided for in this act, it is determined that disposal of a particular parcel will serve the national interest.

Sec. 302.

(a) The Secretary shall manage the public lands under principles of multiple use and sustained yield, in accordance with the land use plans developed by him under Section 202 of this Act when they are available, except that where a tract of such public land has been dedicated to specific uses according to any other provisions of law it shall be managed in accordance with such law.

(b) In managing the public lands, the Secretary shall, subject to this Act and other applicable law and under such terms and conditions as are consistent with such law, regulate, through easements, permits, leases, licenses, published rules, or other instruments as the Secretary deems appropriate, the use, occupancy, and development of the public lands, including, but not limited to, long-term leases to permit individuals to utilize public lands for habitation, cultivation, and the development of small trade or manufacturing concerns.

b. **Sales, FLPMA Sec. 203.**

(a) A tract of the public lands (except land in units of the National Wilderness Preservation System, National Wild and Scenic Rivers Systems, and National System of Trails) may be sold under this Act where, as a result of land use planning required under Section 202 of this Act, the Secretary determines that the sale of such tract meets the following disposal criteria:

(1) such tract because of its location or other characteristics is difficult and uneconomic to manage as part of the public lands, and is not suitable for management by another Federal department or agency; or
(2) such tract was acquired for a specific purpose and the tract is no longer required for that or any other Federal purpose; or
(3) disposal of such tract will serve important public objectives, including but not limited to, expansion of communities and economic development, which cannot be achieved prudently or feasibly on land other than public land and which outweigh other public objectives and values, including, but not limited to, recreation and scenic values, which would be served by maintaining such tract in Federal ownership.

c. **Withdrawals, FLPMA Sec. 204.**

(a) On and after the effective data of this Act the Secretary is authorized to make, modify, extend, or revoke withdrawals but only in accordance with the provisions and limitations of this section.

(f) All withdrawals and extensions thereof, whether made prior to or after approval of this Act, having a specific period shall be reviewed by the Secretary toward the end of the withdrawal period and may be extended or further extended only upon compliance with the provisions of subsection (c) (1) or (d), whichever is applicable, and only if the Secretary determines that the purpose for which the withdrawal was first made requires the extension, and then only for a period no longer than the length of the original withdrawal period. The Secretary shall report on such review and extensions to the committees on Interior and Insular Affairs of the House of Representatives and the Senate.

d. **Acquisitions, FLPMA Sec. 205.**

(a) Notwithstanding any other provisions of law, the Secretary, with respect to the public lands and the Secretary of Agriculture, with respect to the acquisition of access over non-Federal lands to units of the National Forest System, are authorized to acquire pursuant to this Act by purchase, exchange, donation, or eminent domain, lands or interests therein: **Provided,** that with respect to the public lands, the Secretary may exercise the power of eminent domain only if necessary to secure access to public lands, and then only if the lands so acquired are confined to as narrow a corridor as is necessary to serve such purpose. Nothing in this subsection shall be construed as expanding or limiting the authority of the Secretary of Agriculture to acquire land by eminent domain within the boundaries of units of the National Forest System.

(b) Acquisitions pursuant to this section shall be consistent with the mission of the department involved and with applicable departmental land-use plans.

(c) Lands and interests in lands acquired by the Secretary pursuant to this section or section 206 shall, upon acceptance of title, become public lands, and, for the administration of public land laws not repealed by this Act, shall remain public lands.

e. **Exchanges, FLPMA Sec. 206 (a).**

A tract of public land or interests therein may be disposed of by exchange by the Secretary under this Act and a tract of land or interests therein within the National Forest System may be disposed of by exchange by the Secretary of Agriculture under applicable law where the Secretary concerned determines that the public interest will be well served by making that exchange: **Provided,** That when considering public interest the Secretary concerned shall give full consideration to better Federal land management and the needs of State and local people, including needs for lands for the economy, community expansion, recreation areas, food, fiber, minerals, and fish and wildlife and the secretary concerned finds that the values and the objectives which Federal lands or interests to be conveyed may serve if retained in Federal ownership are not more than the values of the non-Federal lands or interests and the public objectives they could serve if acquired.

f. **Recreation and Public Purpose Act, FLPMA Sec. 212.**

The Recreation and Public Purposes Act of 1926 (44 Stat. 741, as amended; 43 U.S.C. 869-4), is further amended as follows: (a) the second sentence of subsection (a) of the first section of the Act (43 U.S.C. 869 (a)) is amended to read as follows: "Before the land may be disposed of under this Act is must be shown to the satisfaction of the Secretary that the land is to be used for an established or definitely proposed project, that the land involved is not of national significance nor more than is reasonably necessary for the proposed use, and that for proposals of over 640 acres comprehensive land use plans and zoning regulations applicable to the area in which the public lands to be disposed of are located have been adopted by the appropriate State or local authority. The Secretary shall provide an opportunity for participation by affected citizens in disposals under this Act, including public hearings or meetings where he deems it appropriate to provide public comments, and shall hold at least one public meeting on any proposed disposal of more than six hundred forty acres under this Act."

g. **Rights-of-Way.**

(1) **FLPMA Sec. 501.**

(a) The Secretary, with respect to the public lands and, the Secretary of Agriculture, with respect to lands within the National Forest System (except in each case land designated as wilderness), are authorized to grant, issue, or renew rights-of-way over, upon, under or through such lands for—

  (1) reservoirs, canals, ditches, flumes, laterals, pipes, pipelines, tunnels and other facilities
  (2) pipelines and other systems for the transportation or distribution of liquids and gases, other than water and other than oil, natural gas, synthetic liquid or gaseous fuels,

or any refined product produced therefrom, and for storage and terminal facilities in connection therewith;

(3) pipelines, slurry and emulsion systems, and conveyor belts for transportation and distribution of solid materials, and facilities for the storage of such materials in connection therewith;

(4) systems for generation, transmission, and distribution of electric engergy, except that the applicant shall also comply with all applicable requirements of the Federal Power Commission under the Federal Power Act of 1935 (49 Stat. 847; 16 U.S.C. 791);

(5) systems for transmission or reception of radio, television, telephone, telegraph, and other electronic signals, and other means of communication;

(6) roads, trails, highways, railroads, canals, tunnels, tramways, airways, livestock driveways, or other means of transportation except where such facilities are constructed and maintained in connection with commercial recreation facilities on lands in the National Forest System; or

(7) such other necessary transporation or other systems or facilities which are in the public interest and which require rights-of-way over, upon, under, or through such lands.

(2) **FLPMA Sec. 505**
each right-of-way shall contain—

(a) terms and conditions which will

(1) carry out the purposes of this Act and rules and regulations issued thereunder;

(2) minimize damage to scenic and esthetic values and fish and wildlife habitat and otherwise protect the environments;

(3) require compliance with applicable air and water quality standards established by or pursuant to applicable Federal or State law;

(4) require compliance with State standards for public health and safety, environmental protection, and siting, construction, operation, and maintenance of or for rights-of-way for similar purposes if those standards are more stringent than applicable Federal standards; and

(b) such terms and conditions as the Secretary concerned deems necessary to:

(1) protect Federal property and economic interests;
(2) manage efficiently the lands which are subject to the right-of-way or adjacent thereto and protect the other lawful users of the lands adjacent to or traversed by such right-of-way;
(3) protect lives and property;
(4) protect the interests of individuals living in the general area traversed by the right-of-way who rely on the fish, wildlife, and other biotic resources of the area for subsistence purposes;
(5) require location of the right-of-way along a route that will cause least damage to the environment, taking into consideration feasibility and othe relevant factors;
(6) otherwise protect the public interest in the lands traversed by the right-of-way or adjacent thereto.

3. **Other legislation.**

a. **Recreation and Public Purposes Act of 1926** (43 U.S.C. 869 to 869-4, 44 Stat. 741).

Sec. 869(a)(See Section VI A2f above — FLPMA 212).

The Secretary of the Interior upon application filed by a duly qualified applicant under section 869-1 of this title may, in the manner prescribed by sections 869 to 869-4 of this title, dispose of any public lands to a State, Territory, county, municipality, or other State, Territorial, or Federal instrumentality or political subdivision for any public purposes, or to a nonprofit corporation or nonprofit association for any recreational or any public purpose consistent with its articles of incorporation or other creating authority. Before the land may be disposed of under sections 869 to 869-4 of this title it must be shown to the satisfaction of the Secretary that the land is to be used for an established or definitely proposed project.

Form 1279-3
(June 1984)

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Land tenure adjust

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